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Fuel Research.

THE growing importance of the more economical use of fuel was recently emphasised by the action of the Parliamentary Secretary of the Ministry of Transport, Lt.-Col. J. T. C. Moore-Brabazon, who has deserted the political arena in order to take an active interest in a process for the low-temperature carbonisation of coal. He had previously displayed exceptional enthusiasm for reform in our methods of utilising coal, in his public speeches, and his sacrifice of a political career of more than ordinary promise is proof positive of a sincerity which is not always at the back of politicians' fervid utterances.

Almost simultaneously the Report of the Fuel Research Board for 1925 has been issued by the Department of Scientific and Industrial Research (H.M. Stationery Office, price 1s. 3d. net). It lays stress on the increasing tendency to buy coal to specification—especially on the part of foreign buyers—and in this connection draws attention to the work of the Physical and Chemical Survey of the National Coal Resources, which includes the difficult question of sampling large consignments, and the preparation of analyses; for this reason a memorandum reviewing the history and work of the Survey is appended to the Report. The Fuel Research Board itself came into existence in consequence of a recommendation of the Coal Conservation Committee in 1916, dealing with the subject of a chemical survey, but it was not until 1922 that the Survey was put in hand. The importance of buying coal to specification is not fully realised by electrical engineers, partly, perhaps, because from time to time—through wars and strikes—they are compelled to buy anything that will burn, regardless of its calorific value; but we have no doubt that in more settled times they will devote more attention to the subject. The presence of an excessive proportion of ash and moisture in their fuel imposes upon them financial burdens which commence at the pit's mouth and continue to exercise their baleful influence to the ash tip itself, increasing the cost of freightage, storage, boiler plant capital and maintenance, labour, and cartage, besides reducing the efficiency of the boiler plant and in some cases causing a nuisance to neighbours.

Much of the work of the Board, of course, relates to gas manufacture, but experimental research in connection with low-temperature carbonisation is constantly in

progress, and has a direct bearing on the future of electricity supply. Not only may the coke and gas be used in power stations, but also the fuel oil derived from the tar will be of the greatest service to internal-combustion engine plant when low-temperature carbonisation becomes a commercially practicable proposition. But that time is not yet, though a very few processes show signs of ultimate success.

The Board has also published two reports on domestic heating, and will co-operate with the Building Research Board of the Department in further work on this important subject at the new research station near Watford. From figures contained in a valuable appendix to the Report, it is interesting to note that in 1924, 22.4 per cent. of all coal consumed in this country was used for domestic purposes; colliery engine power absorbed 9.2 per cent., railway locomotives 7.5 per cent., gasworks 8.5 per cent., and electricity works only 4.3 per cent.

The Central Electricity Board.

CONSIDERABLE interest and speculation have been evidenced of late as to the composition of this Board. This is natural, for upon a wise selection a very great deal will depend. We understand that some 200 names have been submitted to the Minister of Transport as being suitable candidates for membership of the Board. It appears that a selection will first be made of the chairman, who will then be consulted as to the composition of his Board. It is understood that the Electricity Commissioners are not eligible for these positions, as the Electricity Commissioners are the technical advisers to the Board. The indication is that preference will be given to commercial men, though it will not be a disability to have technical knowledge. At present, it is presumed that the Board will include two members who have electrical qualifications, two who have legal experience, one who is an agricultural expert (preferably also with some knowledge of the various aspects of rural electrification), one Scotsman (north of the Border interests are pressing strongly for this) and other men who have made their mark in the commercial world, including probably an accountant. The chairman and two or three of the members will probably be required to devote their whole time to the business of the Board. Their salaries have not been definitely decided upon, but they are not likely to be anything like as high as those mentioned in the daily Press. The chairman will probably receive £5,000 and the full-time members will be paid on the same salary basis as the Electricity Commissioners, while the part-time members will not exceed the £1,000 a year mark.

The Minister of Transport has duly invited suggestions for names from various associations. Apparently the names put forward by each such organisation were of men who represented their own particular interests, rather than recommendations designed to secure the best composition of the whole Board. This has resulted in the submission of the names of elderly men (as they generally comprise the ex-presidents), more noted for their technical ability than for their business capacity.

The names already mentioned in the Press, as suitable for chairman, have been considerably discounted. Nothing definite is known, or will be known, until the fate of the Ministry of Transport is settled. Even then, though the Board is not a Government department, political influence will probably carry a certain weight in the final selection; already ropes are being worked, and wires pulled in support of various candidates.

More Big Contracts.

TELEPHONE development throughout the world produces a constant flow of remunerative business. The possibilities and the prospects both at home and in various parts of the British Empire are very encouraging. Like electricity supply, it is a section of the industry in which there cannot be mere stationary existence—there must be progress, and progress of a kind which means financial outlay, contracts and employment. The latest substantial orders to be placed in this country have been booked by Messrs. Siemens Bros. & Co., Ltd., of Woolwich, after competitive tendering, and the value is £200,000. The work is for the Commonwealth of Australia (Postmaster General's Department) and includes six automatic telephone exchanges in the Brisbane area, comprising Central 9,400 lines, with a satellite exchange at Paddington, 1,000 lines, and four other satellites—Yeronga 700 lines, Bulimber 800 lines, Sherwood 700 lines, Nundah 600 lines. The installation of these exchanges will provide Brisbane practically throughout with automatic telephones. Three exchanges, South, Albion and Newmarket, also of Siemens Brothers' manufacture, are already in operation. The equipment in all exchanges is Siemens Brothers' automatic equipment No. 16, which is also in use in Edinburgh, and, we understand, will soon be put into service in Sheffield, Brighton and other areas in this country. Another very gratifying contract that it is our pleasure to record this week (see our "Business and Industrial Notes") is that received by the Metropolitan-Vickers Electrical Co., Ltd., for 104 motors of 230 h.p. each for railway electrification work in Spain—the main-line sections of the Norte Railway near Barcelona. The mechanical parts for the motor coaches will be made at the Bilbao works of a Spanish company with which the Metropolitan-Vickers Company is associated.

The Spinning Electron.

IN our issue of March 5th, 1926, we drew attention to the suggestion that the electron was not a mere passive particle revolving round the nucleus of an atom (or otherwise engaged) but might itself be actively spinning on its own axis—an hypothesis which, it was claimed, disposed of a number of difficulties that had been met with in electronic theory. An article by Mr. R. H. Fowler, F.R.S., in the issue of *Nature* for January 15th, explains why "the importance of the spinning model of the electron can scarcely be overestimated," though it is "as yet scarcely appreciated at its full value." The first serious suggestion that the electron should be regarded as something more complex than a mere particle with an external electrostatic field is attributed to Mr. A. Compton, who surmised that it might possess also a magnetic field, such as would arise from the spinning of its charge about an axis. Goudsmit and Uhlenbeck, whose work was the subject of our previous reference, are credited with finally establishing the value of the spinning electron.

The author then shows how this conception elucidates five paradoxical difficulties which arose when the electron was regarded merely as a point charge. These paradoxes are connected with atomic spectra, the Zeeman effect, X-rays, the behaviour of spectra in strong magnetic fields, and diamagnetism. Thus, says the author, the spinning electron has brought order out of chaos in the broad outlines of atomic theory; and another triumph must be laid to the credit of the physicists, who, though they have never seen an electron, are yet able mentally to picture it so vividly that they can assert with conviction that it is not at rest, but is endowed with rapid rotation about its own axis, as well as about the nucleus to which it may be bound. As we have pointed out, each step in electronic theory seems to increase the resemblance of the atom to an infinitesimally minute model of the solar system. Moreover, the spinning electron is not remotely related to the vortex-atom imagined by Lord Kelvin, who suggested that the ultimate particles of matter were vortices in the ether. But vortices possess a different mode of rotation.

As long ago as the nineties of last century Sir Joseph Larmor put forward a theory on similar lines, and definitely suggested that if the atom were regarded as containing electrons, the phenomenon of magnetism should be explained as a rotation of the electrons.

The New Tricity Restaurant.

A Complete Installation at the New All-Electric Restaurant, Strand, London, of Electric Lighting, Heating, and Cooking for a Seating Accommodation of 300 Persons.

THAT the all-electric restaurant is not a distant dream, and that the installation of electrical equipment for dealing with the large cooking requirements of hotels and restaurants is a practical and commercial proposition is evidenced by the establishment of the new Tricity Restaurant at the top of Savoy Street, Strand, London, the opening of which we referred to in our last issue. This new enterprise is the outcome of the restaurant conducted as Tricity House in Oxford Street for the past 14 years, the history of which is bound up with that of the British Electric Transformer Co., Ltd.

Fig. 1.—Pompeian Room, Tricity Restaurant.

Tricity Restaurant, which is capable of seating some 300 persons in two rooms, on the ground and basement floors, may be described as a rest house, for its design throughout is of quiet beauty, in sharp contrast to the whirl of the traffic and business in that part of the City. The rooms are artistically lighted, the "Sun Ray" lighting of the parent company playing no unimportant part in this connection. A well-lit entrance hall affords an inviting approach to a cheerful lounge through which the patrons pass in making for the restaurant.

The lounge is lighted, in addition to "Sun Ray" lamps fixed round the skirtings, by four specially designed semi-indirect wall fittings. These are particularly effective and are constructed of wood and silk.

The lighting of the ground-floor restaurant is probably unique in its variety of methods, although the result is pleasingly uniform. Two artificially-lighted windows of artistic design are equipped with Sun Ray lamps, and at the Savoy Street end of the west wing a large street window is flooded with light from similar lamps arranged internally over the windows. Wall fittings, also equipped with lamps of this type, are so constructed that, by means of swivelled reflectors, the flooding can be arranged upwards or downwards. Two large inverted silk fittings and semi-shell pattern inverted wall fittings provide the main lighting.

The basement or Pompeian room, of similar design to that on the ground floor, is provided with a well-sprung dance floor. The lighting here is duplicated, so that either white or red lamps will serve the room, or a combination of both. Inverted silk fittings, similar to those in the upper room, are provided, and 25 wall fittings of the wood and silk pattern are suitably spaced round the restaurant. A small alcove at one end of the room, shown in fig. 1, is effectively lighted by means of concealed cornice lamps.

While the Sun Ray lamps in the restaurants and other rooms provide very effective lighting, they serve also, of course, as very efficient heating apparatus. An elaborately designed ventilating system also serves the rooms; clean air is provided and the foul air extracted electrically through ducts.

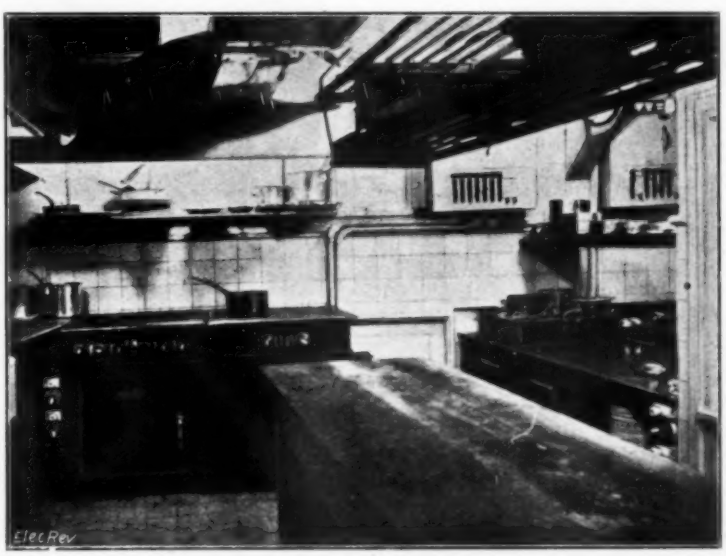


Fig. 2.—One End of the Main Electric Kitchen.

A feature of the premises is a wine bar, very cleverly panelled and plastered after the style of an old-time tavern. This is electrically lighted by means of old Dutch pendant and bracket candle fittings.

The kitchens demonstrate clearly the great saving of space which can be effected when electrical apparatus is installed. They cover a floor space of some 520 sq. ft., and accommodate the whole of the equipment

Fig. 3.—Some of the Electric Cooking Equipment.

necessary to provide a continuous service for the maximum seating of the restaurant, in addition to the necessary working room for the chefs and their staff. At one end of the main kitchen, fig. 2, is a large hot cupboard covered with a hot serving top. This is arranged with two circuits and the total loading is 10 kW. The cupboard is provided with sliding doors. Part of the top of the cupboard accommodates a bain-marie, while suitably placed above the apparatus is a hot shelf. The main cooking operations are carried out by means of two banks of cookers, figs. 2 and 3, each comprising two complete stoves with ovens and hot plates. One cooker in each case is equipped with four open-type and two enclosed boiling plates, each about 8 in. square, and the second cooker is provided with one large enclosed plate about 2 ft. square. The total loading for each bank is 24.4 kW. The elements of the open-type boiling plates are particularly robust and, it is claimed, are unaffected by liquids and foodstuffs being directly spilled on them. They consist of steatite rods on which are mounted specially prepared spirals. The pastry cooking is provided for by means of a bank of four pastry ovens, the total loading being 9.6 kW. Each oven is controlled separately, and is provided with top and bottom heating. The remaining equipment in the kitchen includes two large 3-kW grills and a 3-kW fish fryer.

Two identically equipped still rooms, fig. 4, accommodate the equipment necessary for the preparation of the lighter requirements of the restaurant, such as tea and coffee, and the service necessities. Each of these rooms is equipped with the following:—Two urns, one 1.5 kW and one 0.75 kW; two hot cupboards, one 6.5 and one 3.5 kW; two 2-kW water boilers; and a 1.6-kW boiling plate. One of the hot cupboards is fitted with a small grill and the other with a bain-marie.

Two distribution rooms, one on each floor, house the necessary control equipment for the restaurants and the bar. The supply to the apparatus in the kitchen and still rooms is controlled by specially designed ironclad distribution boards. Each circuit is governed by a d.p. fuse and a s.p. knife-switch, and a lamp indicates when the circuit is "on" or "off" and the apparatus which is supplied by that particular circuit. In order to limit the loading on each distributing board, a sliding-shutter arrangement, fig. 2, prevents more than a given number of switches being put "on" at one time.

The supply for the whole installation is received from the Metropolitan Electric Supply Co. at 6,600 V, 3-phase, and is converted to a 2-phase supply at 200 V by means of a bank of two 75-kW Scott-connected transformers. The whole of the wiring throughout the premises is run in screwed tubing, which is entirely concealed in the restaurants. In addition to most of the lighting equipment, the entire cooking apparatus was supplied by the British Electric Transformer Co.

A lift serves the kitchen and the ground-floor still room, and is used to convey the cooked food to the upper department, from which it is served. The ventilating system, already referred to, also aerates the kitchen and still rooms.

Fig. 4.—Still-Room Apparatus.

The architects responsible for the design of the premises were Messrs. Imrie & Angell, who are to be congratulated on having so successfully overcome the considerable structural difficulties. The electrical work was carried out by The Electric Shop of Chiswick.

The Electricity (Supply) Act, 1926.

An Explanatory Analysis of the Provisions of the New Act, and a Critical Review of the Measure from the Legal Point of View.

By W. S. KENNEDY, Barrister-at-Law.

(*Concluded from page* 53.)

IF standardisation of frequency is essential to the carrying out of the proposals for interconnection, the scheme is to provide for it. It should be noted that there is no provision for general standardisation, but only such as is necessary for carrying out the proposals of a particular scheme. When the Commissioners have submitted their scheme to the Board, the latter is to publish it and may, and almost certainly will, hold an inquiry at which all interested parties may be heard. The Board then adopts it with necessary modifications and proceeds to carry it out—that is, in effect, it proceeds to do three things: To arrange with owners of selected stations how they are to be worked; to arrange with some existing undertaker to build any required new stations; and to erect itself the necessary transmission lines. If in the scheme obligations are imposed on any undertakers which they think are prejudicial to them, they may appeal to an arbitrator selected by the Minister from a panel set up by the Lord Chancellor. The idea of the Act is that owners of selected stations, whether local authorities or companies, shall continue to operate their stations and shall themselves carry out any extensions or alterations which are provided for in the scheme or subsequently become necessary. If the owners refuse, which it is hoped is an improbable contingency, the Minister may, on the application of the Board, transfer the station to the J.E.A., if there is one, in the district, and failing a J.E.A., to any approved undertaker. The price to be paid is, roughly speaking, cost properly incurred less depreciation, to be certified by an auditor with an appeal to the arbitrator if the owners disagree. The Board has no right of appeal. The Minister's order transferring the station is not to be enforced until both Houses of Parliament have had an opportunity of discussing it, and if either House presents an address against it, it becomes of no effect. This is one of the most important provisions of the Act, and its existence should go far to make its use unnecessary. But without it the whole idea of co-ordinated generation and the economies to be obtained from it might go for nought.

Where new stations are to be built the Board is to arrange with the most suitable undertaker in the area to build them—not necessarily with a J.E.A., even should one exist. It will be possible, for example, for the Board to arrange with the London Power Company to build one station and the London J.E.A. another in the Home Counties District, if this seems advisable. It will be remembered that, as passed by the House of Commons, the Bill provided that the option of building new stations was given to a J.E.A. where one existed. Since there are only three such authorities, of which London is the most important, the amendment in the House of Lords may almost be regarded as for the protection of the London companies, and it brings the Act more into line with the provision in the Home Counties order that the companies should enjoy a large measure of autonomy.

All selected stations are to be operated under the Board's directions—naturally in consultation with their engineers, who may be appointed as a consultative committee. The electricity generated is to be sold to the Board at cost price, and the 2nd Schedule provides rules for ascertaining this which seem to cover all items which can properly be included. Such amount as the owners require will then be sold back to them by the Board at this cost price, plus a proper proportion of the Board's expenses, less an adjustment to the load and power factor of the station. Or if the general tariff of the Board (what is commonly called the "grid price") is lower, the owners pay the lower price. But it is further provided (Section 13) that if the owners show that they could, if the Act had not been passed, have generated the same quantity of electricity at a lower price, they are not to be charged more than this. This seems adequate protection—it is difficult to see what more could be given, assuming that the Act is to be worked at all.

If a scheme provides for standardisation, or if the Board thinks any further standardisation necessary, it may require it to be done, but must pay the undertakers the expense incurred and advance them the money required, free of interest. A railway company cannot be required under this Act to alter the frequency employed by it, nor can an undertaker supplying current to the railway.

The Board is under an obligation to give a supply to all undertakers in the area when a scheme is in operation—the energy required being obtained from the selected stations: but may not supply (with certain exceptions) to potential customers of power companies, nor in the districts of joint authorities. Other provisions protect the Board against being called on to give a peak load supply only or to incur undue expense in providing transmission lines. Where the Board is satisfied that the price at which it can supply energy is less than the generating costs of the undertakers who ask for a supply, it may require the undertakers to take their whole supply from the Board. Here, again, a difference may be referred by the undertakers to the arbitrator.

The "grid price"—the tariff for authorised undertakers other than owners of selected stations—is, in effect, to be fixed so as to enable the Board to balance its accounts, and is to show fixed and running charges separately. So far as sales to owners of selected stations are concerned, the Board's price is limited by the cost of generation at such stations, and theoretically, at least, this provision might result in the grid tariff being unduly high. Practically this depends on whether the estimates of cost and output prepared by the Commissioners are accurate or not. This is an engineering question on which opinion is, and will probably remain, divided until time decides the issue. If the spirit of co-operation recommended by the ELECTRICAL REVIEW, now that the Act is law, is happily adopted by the electrical profession and industry, the results looked to by the Commissioners and those assisting them will, of course, be far more speedily and surely realised. If this is to be—and in any case if the industry in this country is to progress as it should—it is essential that the smaller and less economical generating stations should be closed down as soon as a supply can be given from a better source. It is the fault of the legislature

rather than the industry that they exist: they are relics of the parochial system. Yet various reasons, not all unworthy, militate against their supersession by agreement, and Parliament has till now been loth to give any body compulsory powers over them. Section 14 of the Act confers this power, carefully guarded from misuse, on the Commissioners.

The Board must first be in a position to supply such energy as the undertakers will require if their station is closed down: it must undertake to give the supply for not less than seven years on specified terms and must satisfy itself that the cost of its supply is below the prevailing generating costs of the undertakers. It then notifies the undertakers that it is prepared to give a bulk supply on those terms, and the undertakers are given a period of three months to consider and to accept or refuse the offer. Should they refuse, the matter is referred to the Commissioners.

The Commissioners, if satified " as regards the next subsequent year that the cost of production . . . . substantially exceeded the cost the undertakers would have incurred had they purchased the like quantity of electricity from the Board," may if they also think " it is expedient that the station should cease to be used as a generating station," require it to be shut down as such and a supply to be taken from the Board. A difference as to whether the cost was substantially in excess of the Board's offer is to be referred to the arbitrator. It must be noted (1) that the cost must not be merely greater, but substantially greater, and though the term is not very definite, it obviously prevents quibbles over ten pounds when the total is many thousands—and (2) even if the Board's price is substantially lower, the Commissioners may consider it inexpedient for other reasons that the station should be closed. In other words, comparative cost is not to be the sole criterion. This compulsory power, from the point of view of those who have brought small stations to a creditable state of efficiency, will be regretted, but in the interests of the community sentimental considerations must give way.

In this group of sections only one more point can be noticed in a summary review. Section 19 provides that if any scheme made under this Act conflicts with any obligation laid on a J.E.A., local authority, or other undertaker or company under the London and Home Counties Order, the scheme made under the Act is to prevail. This is a distinct limitation on the powers of the London J.E.A., although it is, of course, competent for the Board to frame a scheme in accord with the wishes of that authority, and its views will be heard with respect. Yet the Board may override them should it appear expedient.

3. Subsidiary Provisions as to Board.

These are less important provisions. Sec. 20 (*inter alia*) prohibits the Board from supplying directly to persons who are not authorised undertakers, except to owners of selected stations who are not authorised undertakers (which will be very unusual) or to companies or others for power purposes, in an area which is not part of the area of an authorised undertaker. Persons or companies taking such a supply may use it for lighting any premises where the energy is used for power. This provision enables the main transmission lines of the Board to be tapped where they cross unoccupied territory, so to speak, if the operation is feasible. There is no obligation on the Board to give such a supply. Should a line be available in any place where a fairly substantial amount of energy might be employed, it is, of course, open to any company or body to become an authorised undertaker, when the Board will be under an obligation to supply on the terms of Sec. 10; that is, a reasonable return on the outlay required to give the supply. A subsidiary but important provision is contained in Sec. 21, which gives the Board power to acquire land or easements compulsorily for main transmission lines if the acquisition of a wayleave under the Act of 1919 does not meet the case efficiently and economically. With the extended erection of main transmission lines contemplated by the Act, the question of wayleaves becomes of great importance. Where owners are unreasonable, this provision may be valuable.

4. Financial Provisions.

These provisions of the Act have been much more abused than understood. The Board is not to receive large grants of public money with which to erect superstations and compete with existing undertakers. As has been shown, the Board is not to build or generate at all—save in very exceptional cases—and no question of competition can arise. A cursory reading of Secs. 26-30 will reassure those who had any idea that the Board is to be largely subsidised at the expense of the taxpayer. For certain specified purposes the Board is authorised to borrow money, and this it will do by the issue of stock in the ordinary way to the public. The Treasury comes in only to "guarantee in such manner as they think fit the payment of the interest and principal . . . or of either the interest or the principal." The public have shown no reluctance lately to put up money for electrical schemes without demanding an unreasonable return, and there is little doubt that the Treasury guarantee will enable the Board to raise its money without unduly burdening its undertaking. If this proves correct, the mere existence of the guarantee will ensure its not being called upon. The purposes for which the Board may borrow are given in Sec. 27, and are as follows:—(*a*) The construction or acquisition of generating stations, main transmission lines, and other works; (*b*) any other payment or permanent work, the cost of which the Commissioners think should be spread over a number of years, including payment of interest out of capital for such period as the Commissioners and the Treasury may determine; (*c*) working capital; (*d*) any other purpose for which it is authorised to borrow. The total maximum amount which may be borrowed is £33,500,000, and the Board may not borrow more without a Special Order under Sec. 26 of the Act of 1919. This sum of 33½ million pounds is not allocated in any way in the Act to any specific purpose, and it is not an optimistic engineering estimate which may be exceeded by actual cost. The figure, however, is obviously derived from estimates put before Lord Weir's Committee, and may be taken roughly to represent £24,000,000 for transmission (including necessary gear) and 9,500,000 pounds for standardisation of frequency. A slight digression may be pardoned here in view of the great importance of this matter. The full effect of the capital expended, both in revenue and in capital charges, &c., may be expected to be realised about 1937. The capital charges (interest and sinking fund) on the £24,000,000 expended on transmission may amount possibly—if interest is paid out of capital during the earlier years—to anything from 10 to 15 per cent. Taking an intermediate figure of 12 per cent., the annual charge would be 2.88 million pounds. It does not seem unduly optimistic to assume that in ten years' time the total units sold will be in the neighbourhood of 16,000 millions. If this figure is reached, the additional cost due to the grid system will be .04d. per unit sold. Against this has to be set off the saving due to interconnection, co-ordination of generation, and the closing down of uneconomical stations. If only the last of these be considered, and in reference to coal costs alone this additional cost can, it seems, be easily offset. The coal costs at the Barton station of the Manchester Corporation, for instance, are given as .142d. per unit sold, while Leeds and Glasgow, both of which are efficient and modern undertakings, have coal costs of .19d. and .2d. per unit sold respectively. The possible saving thus on economical undertakings in this one particular is sufficient to pay for the grid. Taking the average costs of all generating stations and the other factors which will make for economy, the result is, of course, even more favourable.

All borrowed money is to be repaid within 60 years,

and the Treasury is to report annually to Parliament the amount of guarantees, if any, which have been issued. So far as the Act goes, these financial provisions are simple. The Commissioners' estimates when issued in the scheme will, of course, receive and necessitate much more detailed examination.

5. Miscellaneous Provisions.

These sections contain two provisions of importance. Sec. 31 gives power to the Minister to revise a power company's maximum prices when the company begins to take a supply from the Board (except the price for bulk supply to authorised undertakers), and in such revision the saving of cost to the company attributable to the Act is, naturally, to be considered. This is simply an extension of the existing power to revise maximum prices, and only comes into operation when the company is getting supplies at a lower cost. It is one of the methods devised to ensure that the consumer gets the benefit of the Board's working. Power is also given to the Commissioners after due inquiry to abolish the authorisation to make up back dividends which some power companies possess. This has never been done, and if the power companies' position is unchanged is not likely to be operative. It would obviously be unfair to the consumer if the company utilised savings, which were in fact rendered possible by the Board's working, for this purpose. Sec. 32 authorises the Commissioners to impose a sliding scale, if they think it expedient, on other authorised undertakers taking a supply from the Board. The London companies, having such a scale already under the London Acts of 1925, do not come under this section. Other miscellaneous provisions deal with superannuation, lopping of trees, and protection of bridges: they require no special notice here.

6. Amendments of Electricity Supply Acts.

The first amendment is of Sec. 5 of the Act of 1919, and provides that the Commissioners and not "interested parties" are to prepare the scheme for the reorganisation of supply in a delimited district. In view of the larger schemes of the Board, schemes under the earlier Acts are not likely to be numerous. But should any such schemes be necessary, it is a more convenient procedure that one scheme should be drawn up by the Commissioners and criticised by the interested undertakers and others, than that rival schemes should be subjected to the prolonged examination necessary to discover their respective merits. The Commissioners are to consult with the authorised undertakers in the district before drawing up their scheme, so that their views and objections may be considered before the formal inquiry.

Secs. 39-40 deal with purchase rights. After December 15th, 1926 (the date of the Act), if a company is authorised to supply in an area covered by two or more local authorities, the purchasing authority is to be the J.E.A. for the district, if there be one, and if not, a joint committee of the local authorities concerned. This does away with the absurdity of the purchase of part of an undertaking. The purchase price is to be a sum equal to the capital properly expended, less depreciation, on a scale to be fixed by the Special Order authorising the supply. And the company's tenure is to be fifty years. Where a company has ceased to generate for itself and is taking a bulk supply, its generating plant no longer being used, would not be purchaseable under the 1888 Act. It is now provided (Sec. 40) that the purchase price is to include a sum representing the capital properly expended on the disused plant after deducting the amount which, the Commissioners think, should properly have been written off. This provision will make it much easier for a company to take a bulk supply and so assist the general scheme, while it prevents an unfair advantage being taken by the purchasing authority. Power is given to undertakers and local authorities having purchase rights to alter the purchase terms by agreement, with the approval of the Commissioners. Sec. 43 is important. Its intention and, it is to be hoped, its effect is to ensure that local authority undertakers should pass on any benefits received in the way of a cheaper supply by the operations of the Board to their consumers. It is sought to achieve this, in a somewhat roundabout way, by diminishing the amount which the authority may apply to reducing rates. In the case of companies, it may again be noted, this result is to be obtained by the imposition of a sliding scale under Sec. 32. Secs. 46 and 47 introduce some needed amendments with regard to railway supplies. The first provides that, with the consent of the Commissioners, any one railway generating station may supply to any other, and the Commissioners may authorise the breaking-up of streets, &c., necessary to carry out this supply.

Sec. 47 merits closer attention. It provides generally that where any authorised undertakers are supplying energy for haulage or traction to a railway, dock, harbour, or canal, they may supply the energy for any purpose and to be used in any part of the undertaking, and the company taking the energy may use it for any purpose for which it is authorised to use electricity. It should be remembered that this will not enable a railway company to undertake the lighting of houses not part of its premises, nor will this section override any protection given in other Acts to particular undertakers, *e.g.*, to Poplar, in the London Act of 1925.

The sale of fittings is dealt with in Sec. 48, and this vexed question is put on a more satisfactory footing. A general power is here given to joint authorities and local authority undertakers to sell (but not to manufacture) fittings, and provides that they are not to undersell the usual providers of such things. The Commissioners are to appoint a representative committee to determine prices and advise generally on the methods of carrying on the business. If it can be properly developed, a large increase in consumption, and therefore a reduction in price, may be hoped for in this direction.

The seven schedules to the Act are largely technical, and for that reason, if for no other, are outside the scope of this article.

Opinions differ greatly about the Act, and its provisions being arrived at by discussion and compromise, it is not a logical whole, and defects are bound to become apparent in its working. In the writer's opinion, it is, however, a great step forward, and if the various interests can follow the advice disinterestedly given now by many of their leaders who were opposed to the Bill, and co-operate to make it a success, it will prove a measure of benefit to the industry and to the country as a whole.

The Central Electricity Board.

According to the *Westminster Gazette*, the name of Sir Duncan Watson, the first chairman of the London and Home Counties Joint Electricity Authority, has been put forward to the Minister of Transport by some of the bodies that he has consulted with regard to the chairmanship of the Central Electricity Board.

The *Manchester Guardian* states that the National Joint Industrial Council for Electricity Supply has nominated some of its own members for membership of the Board, the employers having chosen the chairman, Ald W. Walker, and Ald. Huntsman, whilst the employés' side has nominated Mr. J. Rowan, vice-chairman and general secretary of the Council, and Mr. G. P. Dean.

It is rumoured that the name of Mr. Ll. B. Atkinson, director of the Cable Makers' Association, has been put forward for the chairmanship of the Board; and those of Mr. R. Borlase Matthews and Mr. J. W. Beauchamp, of E.D.A., have been mentioned for membership.

We refer to the position of affairs in our leading columns to-day.

Our Overseas Electrical Markets.

The Trend of Trade with Australia, New Zealand, India, and Africa. Factors Affecting Purchasing Power.

THERE is a growing realisation on the part of manufacturers and exporters in this country of the importance of keeping themselves acquainted with trade movements not only in the markets in which they may be especially interested, but also throughout the world in general. It is fairly well known how large a number of organisations—official, semi-official and private—in the United States are engaged in compiling and circulating statistics and other useful data regarding international trade exchanges and business conditions. Although a great deal has been done in the same direction in this country, it is probable that intelligence of an economic nature is available in greater detail and more widely disseminated in the United States, than in Great Britain. There is little doubt that more money for such purposes is available across the Atlantic than here.

The policy of the ELECTRICAL REVIEW has always been to devote as much space to statistical information as could be spared, having regard to other demands made upon its columns. Manufacturers and exporters have been made aware, as soon as official returns were available, of the annual trend of the import trade in electrical and allied material of practically all the most important consuming countries. Similarly, they have been enabled to watch the activities of competitors, through the comparative tables published from time to time of the exports of the chief electrical manufacturing countries. That manufacturers' representatives and other readers have found these figures of value is certain. On occasions when, owing to exigencies of space or other reasons, some of this information has been curtailed, there have been requests to supplement the details and we have been pleased to meet the demand.

In this article we develop these statistical features and show, by means of charts, the trend of the electrical import trade of certain of Great Britain's most valuable markets during the month. At the same time a brief review is given of the principal factors affecting the purchasing power of the countries in question. By glancing at the charts, firms will be able to see how business has been varying from month to month, and, if a rise in imports has not been accompanied by an increase in their own orders from the market in question, they may consider it desirable to investigate the reasons.

Australia.

Although Australia experienced an unfavourable season last year for the products of her sheep, cattle, fruit-growing and farming industries generally, resulting in an adverse balance of over £20,000,000 during the first quarter of the 1926-27 fiscal year, traders towards the close of 1926 were optimistic as to the outlook. Prospects for the realisation of the wool clip, for the wheat harvest and butter production were considered satisfactory. In the course of a recent review by the Canadian Trade Commissioner at Melbourne, it is stated that trade has generally been well maintained, although some distributing houses report that tight finance, particularly in country districts, has had a depressing influence. The textile mills, metal works, and rubber factories are showing increased outputs, while manufacturers generally are working full time. The recently-published balance sheets of large trading and manufacturing companies show improved

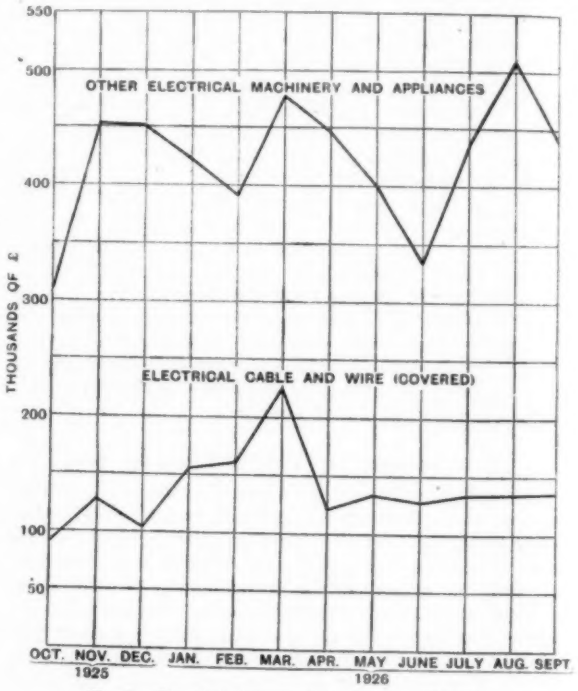


Fig. 1.—Electrical Imports of Australia, 1925-26.

results, while new issues of companies' shares have been readily absorbed by investors. Electrical imports for 12 months are shown in fig. 1.

New Zealand.

Although the value of New Zealand's exports during the first nine months of 1926 showed a decline of nearly £7,000,000 compared with 1925, the excess of imports was but £57,000. The fall in exports was due to lower prices, particularly of wool. The area under wheat and oats during the 1926-27 season is likely to be greater than in the previous season.

Building activity in the Dominion, as measured by the permits issued in the larger towns, well maintains its level. The total value of these permits for September, 1926, was again over £1,000,000 as in June, 1926, and October, 1925. In the intervening months it averaged £750,000.

At the end of the last financial year (March 31st, 1926) the total amount to the credit of depositors in the New Zealand Post Office Savings Banks was £47,911,322, as compared with £46,948,628 during the previous twelve months. During the first six months of the current financial year the excess of deposits over withdrawals was £56,000.

Imports generally into New Zealand fell off directly the effect of the British coal strike began to be felt, and for a time most buyers continued to operate cautiously. Now, however, it is anticipated that import business will revive for a spell. According to the

Canadian Trade Commissioner at Auckland, while conditions in New Zealand in November were not so bright as is usual at that time of the year, there was little cause for alarm.

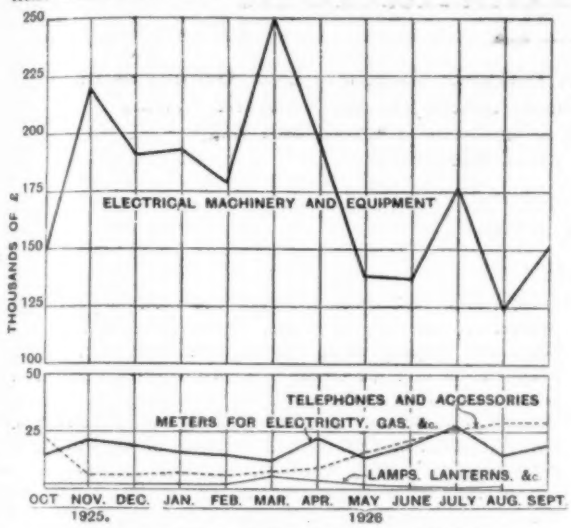

THOUSANDS OF £
ELECTRICAL MACHINERY AND EQUIPMENT
TELEPHONES AND ACCESSORIES
METERS FOR ELECTRICITY, GAS, &c.
LAMPS, LANTERNS, &c
OCT. NOV. DEC. JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEPT.
1925. 1926

Fig. 2.—New Zealand's Electrical Imports, 1925-26.

The advent of the Christmas trade was expected to help the employment situation. Fig. 2 shows twelve months' electrical imports.

India.

The favourable monsoon and the good condition of the various crops are favourable factors that will have their influence, sooner or later, on Indian business in general, but neither trade generally nor that in metal goods and engineering products has been helped by the situation in cotton piece goods. The steady decline in textile prices has placed dealers in a difficult position, for their stocks are large.

The engineering trades are likely to continue to benefit in many ways from the programme of railway and port work, to which the Viceroy referred at the recent meeting of the Associated Chambers of Commerce of India. India, he said, was on the eve of a great expansion of communications. A web of cross lines between the main trunk railways was being built, the smaller ports were to be developed and roads improved. Figs. 3 and 4 show the Indian electrical imports for 12 months.

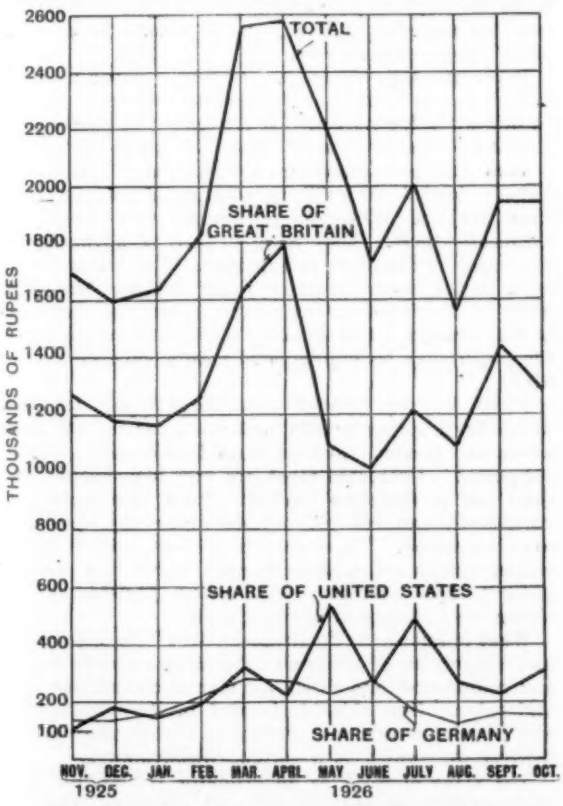

THOUSANDS OF RUPEES
TOTAL
SHARE OF GREAT BRITAIN
SHARE OF UNITED STATES
SHARE OF GERMANY
NOV. DEC. JAN. FEB. MAR. APRL. MAY JUNE JULY AUG. SEPT. OCT.
1925 1926

Fig. 3.—Indian Electrical Apparatus Imports, 1925-26.

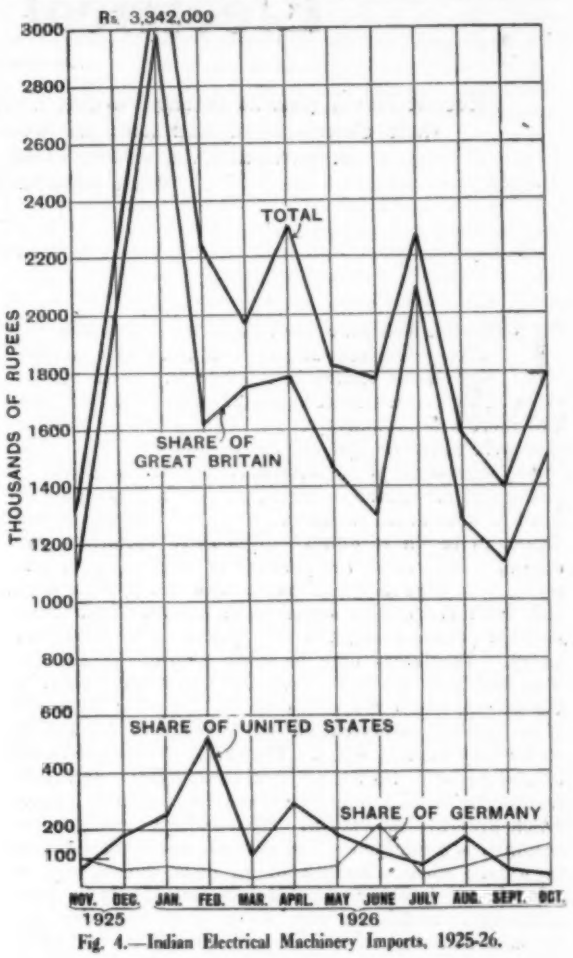


Fig. 4.—Indian Electrical Machinery Imports, 1925-26.

South Africa.

The mineral production of the Union of South Africa in October was about £600,000 more than in the same month of 1925, *viz.*, £5,279,000, as compared with £4,665,000. The index number of European employment in manufacturing industries in August showed a general improvement, and the total number of Europeans placed in employment, apart from relief and public works, by the Government employment exchanges increased from 440 in September to 600 in October. The number of persons on relief and Government works decreased from 4,047 in September to 3,700 in October. The 1925-26 electrical imports are shown in fig. 5.

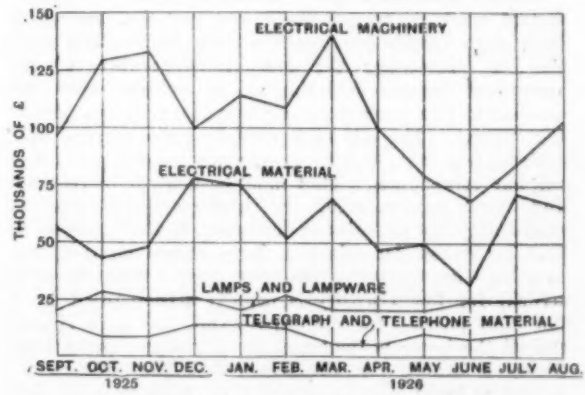

THOUSANDS OF £
ELECTRICAL MACHINERY
ELECTRICAL MATERIAL
LAMPS AND LAMPWARE
TELEGRAPH AND TELEPHONE MATERIAL
SEPT. OCT. NOV. DEC. JAN. FEB. MAR. APR. MAY JUNE JULY AUG.
1925 1926

Fig. 5.—South African Electrical Imports, 1925-26.

Electrical Insulation.

Recent Developments in the Varying Uses of Different Materials: Brief Definitions of their Composition and some of their Characteristics; to the Synthetic Resins, in particular, a wider Field of Usefulness is open than has been allotted to them hitherto.

By ANTONY SETON.

THE time has gone when there were available only a very few substances which acted as insulating agents for electrical conductors. With the advance of electrical science chemical science has kept pace, and there are nowadays very many insulating mediums that were never thought of a few years ago.

An insulator is a substance which impedes the passage of an electric current, and it is difficult to say when a substance ceases to be a bad conductor and begins to be an insulator. Generally speaking, substances which allow the passage of high-pressure currents, but impede low-pressure ones are spoken of as bad conductors, and those which prevent both high- and low-pressure currents are spoken of as good insulators. Insulators may be solid, liquid, or gaseous. Most fall into the first class, but there are several in the second, and a few in the third. Dry air forms one of the best insulators known, but it is apt to break down under very high pressure. Under the heading of liquid insulators are classed all non-electrolytes, and some electrolytes also, when dissolved in an inert solvent which prevents ionisation. Hydrochloric acid gas, for example, is a conductor, and remains one when dissolved in water; when dissolved in an inert solvent such as chloroform, however, it becomes practically a non-conductor. Absolutely pure water is an insulator, but the salts dissolved in it ordinarily give it good conductivity. Pure mineral oils are insulators, but fatty oils are not. Mineral oils find application in transformers and switchgear more particularly. Solid insulators include substances like paper, rubber, gutta-percha, mica, and the synthetic resins and gums made by the condensation of aldehydes and phenols. Gaseous insulators are not used in practical work, except in so far as bare overhead conductors are insulated by the air round them, and do not spark to earth except under very unusual conditions.

Liquid insulators find considerable use in power-station work in transformers and switches, for which their high specific heat renders them particularly suitable in preventing the rise in temperature of the apparatus beyond safe limits. In switches they are used mainly to prevent arcing when making and breaking contact. The oils used must be pure mineral oils, entirely free from moisture, sediment, and sulphur and sulphur compounds. They must be neutral in reaction and must remain stable at high temperatures. A moderately low viscosity is desirable, as the dispersal of heat generated depends to a large extent on this, but as a high flash point is also necessary, a mean must be struck, for low viscosity is usually accompanied by a low flash point. On the other hand, the more viscous the oil the lower is the break-down voltage, and a high dielectric strength is also required. The voltage required to break down a gap of $\frac{1}{8}$ in. between point and plane in a well-dried oil (traces of moisture makes a big difference) is between 15,000 and 30,000 volts. In transformer work it is found that after a period of use a sludge forms which, in the early stages, is a hydrocarbon simply, but later assumes the character of an oxidised compound, and is acid in reaction.

Varnishes may be divided into two classes, *viz.*: those in which oil is the vehicle, and those in which a volatile solvent is used. They are used to provide a protective coating for wires, especially cotton-covered ones, for impregnating paper and tape, and in the preparation of mica cloth. For windings a varnish of linseed oil, with a base of copal or fossil gum, is used. Windings which may be affected by oil should be treated with this kind of varnish. A solution of asphaltum in oil furnishes another varnish, but one that is not so oil-resisting as a copal varnish, and which, moreover, has a lower dielectric strength. For papers a linseed oil varnish with a gum base is used, to which is added a small quantity of lead or manganese driers, the whole being thinned, if necessary, with benzine or turpentine. Shellac varnish is made by dissolving shellac in methylated spirits until the specific gravity is from .84 to .89. Gum lac or garnet lac can be used in place of shellac. Windings can be protected also by solid impregnating materials, such as asphalt and paraffin wax. It is necessary that the composition, whatever it is, shall be fluid enough to permeate the windings at a temperature not exceeding 125 C., and it must not be brittle at ordinary temperatures.

Paper and tape are frequently used. Paper is cheap, but its use is limited by its moisture content, and its insulating value normally is low owing to its inherent moisture. Paper is made from the fibres of various grasses and plants and from wood pulp. It is frequently loaded with fillers, such as china clay, and these are not deleterious provided that they are chemically inert. They may, in fact, be advantageous in rendering the paper less springy. The use of rubber latex in the manufacture of paper suggests the possibility of an improvement in the insulating properties of the material. For securing a high insulating value, the paper may be impregnated with a varnish of some kind.

Tapes may be divided into three types: (*a*) those woven from cotton or silk and not treated; (*b*) those woven and treated; and (*c*) those loaded with a rubber compound. Untreated tapes are very hygroscopic, and their use is therefore limited. Tapes that have been varnished stand well, if they were bone dry when they were varnished. Tapes that have been loaded with a rubber compound cannot be used where they are exposed to light and air, as the rubber perishes quickly under the influence of air and light.

What is known as "vulcanised fibre" finds extensive use. It consists of cellulosic materials chemically treated and compressed into sheets, or manufactured into rods and tubes. Zinc chloride is used in its manufacture, and for this reason the product is always more or less hygroscopic, which is a serious disadvantage.

The value of wood as an insulator is determined by its condition as regards sap and moisture, and the drier the wood the better the insulation obtained. Well-dried wood, it is said, should stand 10,000 volts per inch of thickness without overheating or burning. Ash, teak, maple, hornbeam, and lignum vitæ are all used, and of these hornbeam is the best. Additional protection may be given by boiling the wood in oil, linseed oil for preference, but the pieces should be cut to size before this treatment, as the protective coating does not extend deeply into the substance of the wood.

Of mineral insulators there are several. Slate and marble are used extensively, but frequently give trouble owing to metallic veins which run through the slabs. Slate is a worse offender in this respect than marble, but even marble is not free from such veins. Slate can be treated with a varnish which renders surface leakage small, but holes for conductors must be bushed with vulcanite or one of the synthetic resins. Porcelain, when of good quality, is very good, but when it is of poor quality its value as an insulator is due entirely to the glaze, which may be full of pinholes and very imperfect. The mineral most widely used is mica. The micas are a family of related minerals which differ slightly in chemical composition. They are all complex aluminium silicates or alumino-silicates, and are distinguished by the ease with which they cleave into thin laminæ, which are flexible and more or less elastic. The three forms which are used chiefly in electrical work are muscovite, first found by A. B. de Boodt in Moscovia; amber mica, mined in Canada and so called because it is amber in colour; and lepidolite, which is chiefly obtained from India. Of the three, muscovite has the highest dielectric strength, but it is hard and not so easy to work as the others, and consequently is used less. Crystals of muscovite measuring 10 ft. across the basal planes have been found in India, but these are uncommon. Crystals of from 6 to 12 in. are common, however, and sheets 30 in. by 24 in. have been obtained in Canada free from flaws. Oil has a very harmful effect on the material, and T. O. Maloney found that a piece of mica which withstood 16,000 volts alternating current broke down under 9,000 volts after being lightly wiped over with paraffin oil. One of the chief uses of mica is for interposing between the segments of the commutators of motors, and the breakdown voltage of sheets 0.12 mm. thick has been given as 10,000 volts. Mica waste is made up into what is known as micanite, or mica cloth, by bonding the fragments with shellac varnish on a fabric base. Asbestos, another complex silicate, is also used, but its hygroscopic nature and poor insulating qualities make its scope limited. For fuse blocks and switch blocks it is used after impregnation with sodium silicate.

Rubber is produced from the sap of a number of trees, but chiefly from the Hevea brasiliensis. The sap, or latex, is a milky fluid holding the rubber in suspension in the form of exceedingly minute particles. By evaporation of the water, or coagulation, the rubber is obtained, and after washing is exported from the plantation in the form of loaves, balls, crepe or sheet. Pure rubber is little used as an insulator, but high-class cables and flexible conductors frequently have a layer of pure rubber immediately over the wire to prevent the sulphur of the vulcanised rubber from acting on the metal of the conductor. Whilst rubber, being waterproof, might be used for submarine cables, this is not the case owing to the difficulty of making good joints, its unsatisfactory resistance to water pressure (in comparison with gutta-percha) and the difficulty of preventing the action of sulphur on the conductor. Ebonite, or hard rubber, contains upwards of 30 per cent. of sulphur. It is somewhat brittle, but can be turned and takes a very high polish. It has a very high dielectric strength, but softens at comparatively low temperatures. It is not hygroscopic, and is useful where a first-class appearance is essential.

Gutta is obtained from a latex similar to rubber latex. It is a hydrocarbon of very similar character, being $(C_{10}H_{16})_n$, but has entirely different physical properties. It is not pure, but invariably contains more or less resin. At ordinary temperatures gutta is hard and tenacious, but it becomes plastic on warming, and can be moulded, the shape being retained on cooling without brittleness. Gutta is not affected by weak mineral acids, by strong hydrochloric acid, or by strong acetic acid, or by strong alkalis. It is readily attacked by strong nitric acid and strong sulphuric acid however. It slowly absorbs oxygen on exposure to air, becoming converted into a resin, and differs from rubber in that it is not attacked energetically by ozone. The value of gutta as an insulator depends solely on the proportion of gutta present and not at all upon the resin. Removal of the resin by appropriate solvents does not affect the electrical properties at all. Very hard gutta is made by extracting the resin from ordinary gutta.

Many of the synthetic resins form excellent insulators. The original researches were carried out by Kleeberg with formaldehyde and phenol, but those to which we owe most are those carried out by Baekeland, and it is one of his synthetic products which finds so extensive a use now under the name of Bakelite C. Other compounds of like nature have been used, and most of them have some value from the point of view of insulation. It is to be noted, however, that resins produced by the use of acid catalysts are less satisfactory, and have lower insulation values than those in the manufacture of which alkaline catalysts have been used. Bakelite C is a golden yellow compound of specific gravity 1.25. It resists pressure and shock, but is comparatively inelastic. It does not melt on heating, but above 300° C. chars, and at no time does it inflame. It is not hygroscopic and resists the action of strong mineral acids and of bromine. It is not so resistant to alkalis. Its golden yellow colour turns to red on exposure to light, but it has been stated that if the colour is not too deep the original yellow can be restored by heating the resin to 100-150° C. for several hours.

In concluding this account of some insulating materials, it must be noted that the list is not exhaustive, and that much more might have been said about each. The synthetic resins alone open a wider field of usefulness than the space allotted to them indicates, and as time goes on their application in all branches of the electrical industry will become more common and their value will increase to a much greater degree.

Reviews.

Electric Lighting and Power Distribution. By W. PERREN MAYCOCK. Vol. I. Ninth Edition, revised by C. H. YEAMAN. Pp. xiii+562; figs. 392. London: Sir Isaac Pitman and Sons, Ltd. Price 10s. 6d. net.

The lamented death of the author of the earlier editions of this work unduly delayed the appearance of the present edition. The necessary work of revision has been undertaken by Mr. C. H. Yeaman, who, without altering the general scheme of the work, has rewritten a large portion of the text. The popularity of the earlier editions of this book was undoubtedly due, not only to Mr. Maycock's peculiar gift for dealing with his subject in a simple and easily understood fashion, but also to the fact that few other books of similar character were available for the use of the elementary student. At the present time, however, there exists a large number of works of a rudimentary nature, of similar scope to the one before us, and we therefore rather regret that Mr. Yeaman has not made better use of the opportunity presented to him, by treating the subject in a more ordered and logical manner than he has. We very much question, for instance, the wisdom of endeavouring to describe the working of purely alternating-current instruments in a section devoted to the principles and application of direct-current work. These explanations can hardly convey anything to the student who has no knowledge of elementary a.c. principles. It is also to be regretted that the standard symbols for electrical quantities and for diagrams of connections have not been rigorously used. The obsolete symbol C has been retained for current, and a small, instead of a capital, omega has been used as the abbreviation for ohm.

Considering the work in detail, we find a very good introductory chapter dealing with mechanical units of force, energy, and power, which, if thoroughly assimilated, will be of excellent service to the student throughout his engineering studies. This chapter is followed by one dealing with electrical quantities and units, and elementary d.c. calculations. The author then leaves this part of the subject and proceeds to the fundamental principles of condensers, electromagnetism and electromagnetic induction. We then have a somewhat scrappy chapter dealing with batteries, bells, telephones, relays, and elementary transmission and distribution problems. The bulk of this matter should have followed immediately on the chapter on elementary d.c. calculations. The chapter on the magnetic circuit, and magnetic calculations, is a very good one, and deals with a difficult subject in a manner which will be most helpful to the beginner. A very large portion of the book is devoted to standards, measurements, testing and instruments, the two chapters dealing with these matters comprising no less than 211 pages, whilst the concluding chapter of the book,

treating of direct-current dynamos and motors, has 62 pages only. We consider that a more searching treatment of the principles of direct-current machines, affording, as it does, so excellent an illustration of the rudimentary principles discussed in the earlier chapters of the work, would have been more useful to the student than the detailed descriptions of many of the electrical instruments found in chapters 7 and 8. The latter chapters are, however, generally very sound and useful, although we came across one or two rather loose statements. On page 431, for instance, the moving-iron type of instrument is described rather contemptuously, as being suitable only in situations where accuracy is relatively unimportant. As these instruments are now supplied with a guarantee of Grade 1 accuracy, for a.c. work, this reference is hardly a just one, and, moreover, so far from the induction type of instrument superseding other types for a.c. work, as stated on page 463, the use of the moving-iron instrument is distinctly on the increase. On page 383 the author gives a list of the factory tests taken on cables before delivery, and states that these tests should be taken periodically after the cables have been laid. This is quite misleading, for few mains engineers would care to pressure-test their cables at regular intervals. The concluding chapter will serve as an introduction to the study of the elementary theory of direct-current machines.

There are large numbers of questions and exercises at the end of each chapter, and the answers are given to such as involve arithmetical calculation. The book has been admirably produced, and is very well illustrated. It will still rank as one of the best and most inexpensive of text books for the elementary student of limited educational attainments, although we are of the opinion that it would have been even more useful had greater attention been paid to the order in which the various subjects are dealt with, and to the allocation of space amongst them.

Notes on the Induction Motor. By H. E. DANCE, A.M.I.E.E., A.I.A.E., Lecturer in Electrical Engineering at the Birkenhead Technical School. Pp. viii+152; figs. 70. London: Oxford University Press. Price 6s. net.

This little volume is intended for those students of electrical engineering who desire to obtain accurate ideas concerning the theory underlying the operation of the induction motor without entering into matters which may be looked upon as falling within the province of induction motor design. The first chapter deals exhaustively with the production of rotating magnetic fields by means of polyphase currents in suitably disposed stator windings, and this is followed by a chapter in which consideration is given to the actions occurring in a conductor lying within a rotating field. The portion of the book dealing with the general theory of operation of the machine is completed by a study of the approximate circle diagram, the treatment being chiefly considered from the point of view of the utility of the diagram for testing purposes. Stress is laid upon the desirability of employing the phase currents and pressures when laying out the circle diagram, due allowance being made for the number of phases when determining the power scale. This may seem to be a point of minor importance, but we heartily commend the course advocated since we have in mind many cases where students have become involved in difficulties owing to lack of clear ideas as to whether line or phase quantities are under consideration.

In the succeeding chapters of the book, methods of starting, speed regulation, and power factor improvement are considered, and we find all the important methods described, the size of the book, however, necessarily limiting the amount of space devoted to each. The account of the phenomenon of "crawling," often a source of trouble with students, may be particularly commended.

The book concludes with brief accounts of the operation of the induction machine as a generator and of the single-phase induction motor.

The author achieves the object at which he aims, and the book, which is carefully and accurately compiled, can be recommended to the notice of students and engineers alike.

Legal.

Lazenby v. Gardiner

AT Plymouth County Court, on January 12th, Mr. G. C. Lazenby, wireless engineer, Plymouth, claimed the sum of £14 5s., the cost of a radio set supplied to Captain H. B. W. Gardiner, Marytavy, near Tavistock.

Mr. W. J. AMBROSE, for the plaintiff, said that his client supplied a "Marconiphone" receiving set to the defendant, who said that he did not want a loud speaker; headphones would meet his needs better. A cheque given in payment was stopped by defendant, who on the following day wrote alleging that the set was not what it was represented to be, and that he was getting very faint reception. Later the set was returned to plaintiff's shop. Giving evidence in support of this statement, Mr. Lazenby said that when he installed the set he obtained excellent reception from Daventry and good reception from Plymouth. Defendant did not say that he desired to get Continental and English stations other than Daventry and Plymouth.

Mr. FRANK JONES, of the Marconiphone Co., Ltd., said the set was capable, under ordinary conditions, of receiving radiotelephony on headphones up to a distance of 100 miles from a main broadcasting station and up to 250 to 300 miles from a high-power station. It was possible to get Radio-Paris, Madrid or Prague on the set. That day in Plymouth he had got Daventry direct on the loud speaker, and he thought that if the test had been made on Dartmoor reception would have been considerably better. Witness did not believe there were any such things as wireless "pockets," as had been suggested.

Mr. A. R. H. AKASTER, for the defence, stated that their case was that there had been gross misrepresentation by an expert on a technical matter to a person who had no knowledge of wireless. Plaintiff offered to supply a set which would get Continental and English stations apart from Daventry and Plymouth, which the set supplied would not do. Captain GARDINER bore out this in evidence, and Mr. W. E. GRAVES, a Tavistock wireless engineer, who examined the set, was called to report upon it. He gave it as his opinion that the set supplied by Mr. Lazenby had been very badly fitted.

His Honour Judge GURDON, remarking that upon the evidence put before him he was not satisfied that the set would not get the stations mentioned, gave judgment for plaintiff, with costs.

Action Against Stepney Borough Council.

IT is reported that Messrs. Pearson & Son, Ltd., printers, Aldgate, have entered an action against the Stepney Borough Council claiming £100, the amount of loss alleged to have been sustained on account of the cutting-off of the electricity supply during the general strike.

Rating Appeal by Aberdeen Corporation.

THE decision was given in the Valuation Appeal Court, Edinburgh, on January 13th, in the appeal by the Electricity Department of the Aberdeen Corporation against the refusal of the Valuation Committee to deduct sums of £6,971 and £419, in respect of sinking fund and interest on capital expenditure on buildings and plant before these were completed and became revenue producing subjects (*vide* our last issue, p. 53). The appeal was refused, the Court holding that the determination of the Valuation Committee was correct.

Lord SANDS, giving the leading opinion, said that in considering the application of the revenue principle it was necessary to keep in view that the question was not one as to the purpose to which the net revenue was applied or of profits or gains, but solely of the annual value of the subjects the value of which, if they were let, would be spelt in rent paid by a tenant. The revenue principle professed to ascertain this. But it had been contended that productive and unproductive works should be regarded as separate and distinct. Calling the productive works A and the non-productive B, admittedly B had at present no value, and they were not there concerned with putting any value upon them. The problem was to ascertain the annual value or hypothetical rent of A. His Lordship was unable to see how the rent which the hypothetical tenant of A was willing to pay could have any relation to the payments out of that rent by the landlord towards B. His Lordship was accordingly of opinion that the determination of the Valuation Committee was right.

The Court, on the same day, also dismissed appeals in three other cases in which the same question was raised.

Electric Sign Erection Dispute.

MR. JUSTICE FINLAY had before him in the King's Bench Division, on January 12th, an action in which Mr. Lewis Jackson, Gloucester Gate, W., sued Mr. John de Frene, Duck Lane, Wardour Street, W., for £200, one quarter's rent payable in advance for space for electric sky signs upon Harrington Mansions, Cambridge Circus. Defendant entered into an agreement with plaintiff to take the space at a rental of £800 a year. When defendant applied to the London County Council for a licence it informed him that it was superior landlord and that it would not allow electric signs to be put on its property. It appeared that there was a clause in plaintiff's lease to the effect that he would not without the written consent of the lessors cut or damage any of the principal walls or timbers. A clause similar to this was inserted in plantiff's agreement with the defendant. The latter pleaded that he did not know at the time he entered into the agreement that plaintiff had previously tried to get the permission of the L.C.C. to erect electric signs on the premises and that the L.C.C. had refused. In view of the failure to disclose this fact he submitted that consideration for the agreement which he entered into with plaintiff had failed, and therefore the agreement was of no effect in law. Defendant said he had re-let the space and had lost an anticipated profit of £5,000.

His LORDSHIP, in deciding for the plaintiff, said the agreement made it clear the signs to be erected must be in accordance with the lease. The failure to disclose the circumstance that the L.C.C. had previously refused permission to erect the signs was not a fraudulent concealment. If defendant had erected signs and the L.C.C. had taken action the burden would have fallen on the plaintiff. Judgment was entered for plaintiff for £200 and costs.

Business and Industrial Notes.

The Week's Electrical Trade News from all Sources. Commercial and Industrial Developments, Campaign Notes, Business Changes, Market Prices for Materials, Trade Openings, New Publicity Literature, Liquidations and Failures.

The E.D.A.-E.L.M.A. Campaign.

The organisers' report upon the Wiring the Homes of Britain Campaign for the week ended January 15th shows that four new circles were formed during the week at the following places; the chairmen's names are given in parentheses:—Bournemouth and District (Mr. H. F. Alger, secretary Mr. Norman Aish); Chesterfield (Mr. E. Morris); Dorchester; and Cambridge (Mr. Pierce, *pro tem.*). Electric demonstration homes were to be opened during the current week at Glasgow (2), Leicester, Bath, and Exeter, and two more are to be opened at Birmingham next week. The Wembley house has proved a great attraction, and many orders for appliances and fittings have already resulted from it. The builder and the furnisher have also expressed their satisfaction with the results. The Bishop Auckland house is attracting visitors from a wide area, and "excellent attendances and good results" are reported by Walsall. Dorchester has decided to run a demonstration house, and further houses or exhibitions are in contemplation at Bristol and Cardiff. The three-day exhibition at Greenock drew 800 people who paid for admission. Exhibitions are being arranged in a number of towns. That at Derby will include evening lectures on home lighting. The North Metropolitan Electric Power Supply Co. has held an exhibition at Hoddesdon in the form of an electric flat in the basement of the company's local premises. Wolverhampton will hold an exhibition from January 27th to 29th; Bingley has arranged one to run from February 28th to March 12th; and during February and March an exhibition will be held at the Weymouth electricity supply showrooms. Chesterfield contractors are also thinking of organising an exhibition. Successful works meetings are being held in all parts of the country. A recent one at Messrs. Ferranti, Ltd.'s, works was attended by 200 workers; the company has offered an additional prize for any employé who wins one of the ballot prizes. A crowd of 600 people attended a recent works meeting at the Metropolitan-Vickers staff canteen, Trafford Park. It is suggested that competition booklets might be given away by large manufacturers with the weekly pay envelopes. Bingley contractors have sent out 3,400 copies of the booklet, with a covering letter, to the principal residents of the town.

A pamphlet describing the Glasgow electric demonstration houses has been received. The first of these houses was opened this week at Muirend; three others are to be opened at later dates. The following are co-operating in the arrangement of the houses:—The Corporation Electricity Department, the Clyde Valley Electrical Power Co., the Strathclyde Electricity Supply Co., Ltd., electrical manufacturers and local wholesalers and contractors.

The German Cable Industry.

The *Deutsche Bergwerks Zeitung* learns that the order of the Reich Railways for 230 km. of cable, valued at approximately 6,000,000 marks, has at last been placed. As the order has been distributed among about a dozen cable companies, each company receives a share which will only give it employment for about a month. Delivery is to be made before the middle of 1927. With regard to the recently-completed cable from Berlin to Vienna, the paper learns that the German section is being laid by the Süddeutsche Kabelwerke, of Munich, Felten und Guilleaume, of Nüremberg, and the Kabelwerke Duisberg; the value of the order received by these concerns is estimated at between three and four million marks. —*Reuter's Trade Service* (Essen).

National Fuel and Power.

The Fuel Economy Department of the Federation of British Industries has received a request from the National Fuel and Power Committee appointed by the Government as a result of the recent Royal Commission on the Coal Industry, to be supplied with an account of the work undertaken by the Department. A Memorandum has accordingly been submitted to the Committee, and attention has been drawn to some problems of urgent industrial importance.

G.E.C. Exhibitions.

In conjunction with the local electricity authorities the General Electric Co., Ltd., has organised three exhibitions. The first opened on Tuesday last and will run until January 29th. It is being held at the Stoke Newington Electricity Department's showrooms. The second opens at the Hampstead Electricity Department's premises on January 22nd and remains open until January 29th. The last takes the form of a special window display of domestic electrical appliances at Hackney from February 7th to 19th.

The F.B.I. and the Next Budget.

The Grand Council of the Federation of British Industries has communicated with the Chancellor of the Exchequer setting out its views with regard to taxation in view of the near approach of the presentation of the next Budget. Economy in policy and administration is stressed as essential and the Council recommends that wherever the Chancellor may look for money, there shall be no increase whatever in direct taxation. The loss of revenue resulting from the coal stoppage should be regarded as a capital loss to be spread over a term of years. Other matters dealt with are the incidence of super-tax and the change-over in the basis of assessment.

Unemployment in Germany.

The returns of German unemployed show that there was an increase of about 278,000 during the last two weeks of 1926. The number in receipt of relief at January 1st was 1,745,000.

The Leipzig Fair.

We have received from the organisers of the Leipzig Spring Fair a number of pamphlets, &c., dealing with the display. The Technical and Building Fair is to be held from March 6th to 13th and the scope is wide, judging from a list of the goods that will be shown. The London office of the organisers is at 1, Gower Street, W.C.1.

Electrical Exhibits at Leeds.

At the Leeds Building Trades Exhibition, opened last week, Messrs. William E. Culkin & Co., manufacturing electrical engineers, Leeds, showed numerous examples of electric fires, cookers, washers, vacuum cleaners, and other household appliances. The firm also showed many kinds of electrical plant for industrial purposes, including dynamos, motors, switchgear, drills, meters, and various electrical instruments. A motor-driven planer and saw and the firm's own "WEC" blower were also exhibited. Mr. Arthur English, electrical contractor, Leeds, was responsible for the whole of the electrical work throughout the exhibition. He showed a model bungalow equipped with electrical appliances.

The Swedish Electrical Industry.

The electrical manufacturing industry in Sweden continued to improve last year. There was an increase in the value of the exports from 18.4 millions of kronen in the months of January-November, 1925, to 24.4 millions in the same period in 1926. In the case of the telephone industry further progress was made last year. The orders booked amounted to about 20 million kronen, of which 16.3 millions applied to foreign contracts. During the year the orders executed represented a value of about 14 millions, and the stock of orders at the beginning of 1927 was 20 millions, or twice the value of those in 1924.

Radio Apparatus Trade in Norway.

Various new broadcasting stations were established in Norway last year and it is said that such stations will cover the whole of the country at no distant date. It is calculated that the value of the wireless receivers already sold amounts to 8,000,000 kr., there being 100,000 registered owners. Good progress has been made with the development of the home radio manufacturing industry, which is claimed to be able to compete with foreign products in the matter of quality.

Messrs. Lister's Jubilee.

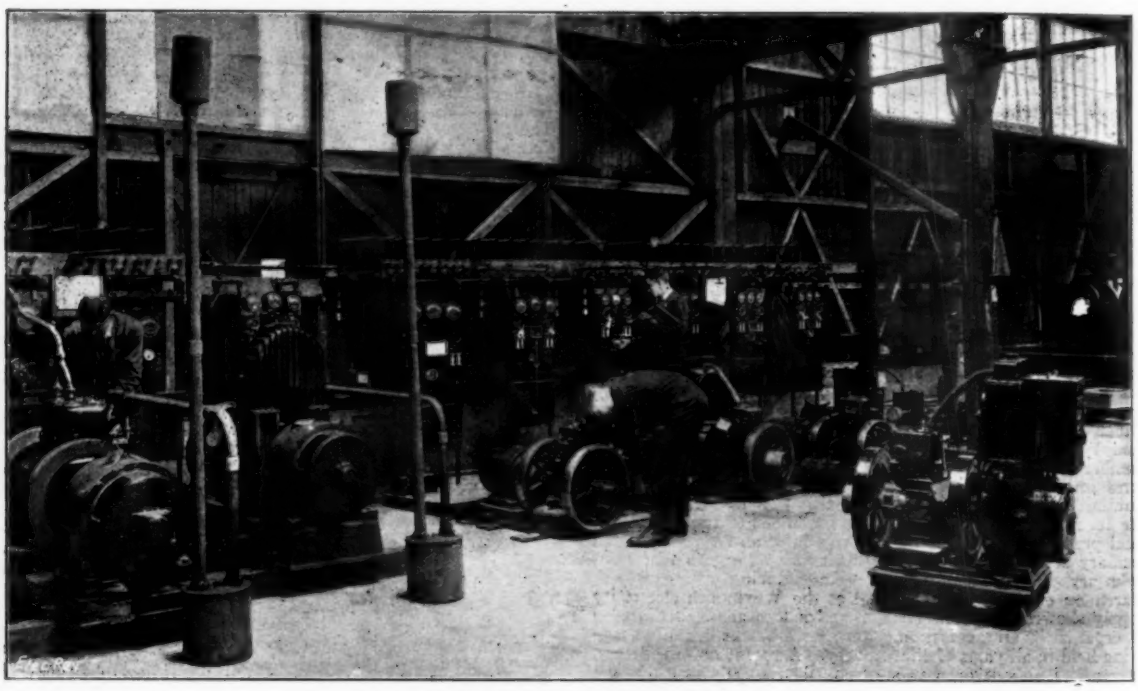
Last week Messrs. R. A. Lister & Co., Ltd., Dursley, Gloucestershire, celebrated their jubilee, and part of the proceedings consisted of tours of the works by p. of the company's distributing agents, electrical contractors, agriculturists, and members of the Press. The works is notable for the variety of products which it makes—ranging from butter churns to lighting sets. The shops are well laid out and equipped with the most modern labour- and time-saving machinery, practically all of which is driven electrically—mainly by overhead motors and line shafting. Messrs. Lister have a very large Continental and Dominion connection, generally taking the form of subsidiary companies in the countries concerned, and they have penetrated the United States market to a remarkable degree. In the production of "Lister" engines, which range from the equivalent of one to 10 kW, the work moves through the shops in a logical manner and is thus turned out with a minimum of labour and handling expenses. A feature noticed during the visit was a card on each large machine stating the cost of the machine and the running cost per hour when working and when idle, enabling the operators

Anglo-French Discussions: F.B.I. Statement.

In view of certain inaccurate statements which have been published purporting to give details as to the scope of the proposed Anglo-French industrial conversations and the composition of the delegations, the Federation of British Industries has issued a statement that, up to the present, no definite arrangements have been made on either point. The present position is that the idea of such a discussion has been accepted in principle by both sides, but that the details remain to be worked out, when an authorised statement will be issued.

British Goods in New Zealand.

British Industries, quoting from the annual report of the New Zealand Association of British Manufacturers and Agents, says that during 1926 the bulk of the Government purchases of hydro-electric equipment, railway material, &c., were made from British firms, though there is still a good deal of business passed to foreign countries which could with advantage be placed in Great Britain. Local bodies have also mainly given preference to British goods. American



Testing "Lister" Electric Lighting Plant.

to understand that machines represent a burden when not running, apart from the stoppage of production. The impression gained from the inspection of the shops is that the work is carried out at a good pace, but without undue hurry. Most of the men are on piecework, which induces a sustained effort and they are afforded every assistance in the way of jigs and tools. It is noteworthy that no female labour is employed in the shops. The engines are subjected to thorough test before leaving the works. Our illustration shows a number of lighting and pumping plants on test in a department which also serves as a "showroom." Although this side of the company's business is very important, there are other branches of equal or greater moment. The works produces agricultural and dairy appliances, including ploughs, cream separators, butter churns, &c., which are known all over the world. Ornamental tubs, fire screens and other woodwork of a domestic kind are also made in large quantities. The stock of timber alone is valued at £25,000. The works covers an area of over eight acres and is well served in the way of transport. One of the latest developments shown to the visitors was an "Auto-truck," a runabout conveyor for workshops and loading platforms. This has a small petrol engine and simple controls. The company extended the most complete hospitality to its visitors during their short stay.

A Battery-Charging Chart.

We have received a copy of a new Exide publication which is one of the most useful things that have so far been issued. The primary intention is to provide at a glance all the needful information regarding the re-charging of all types of Exide batteries, and it is suggested that the chart should be fixed in garages, service stations, and any other places where batteries are charged. The comprehensive nature of the information it furnishes is another indication of the readiness of the makers to render the maximum service to all users of batteries and those who undertake the care of batteries. Copies may be obtained on application to the Chloride Electrical Storage Co., Ltd., Clifton Junction, nr. Manchester.

firms practically control the market in garage air compressors, vacuum cleaners, washing machines, refrigerators, &c., though British makes of electric irons, kettles, &c., are now securing a large proportion of business. In electric cooking ranges there is a wide field for improved British products. Radio sets, &c., require to be more adapted to New Zealand requirements.

A German Export Selling Concern.

It is stated that a number of German electrical firms have formed a joint combination under the title of the Sales Company of the Special Electrical Works, of Berlin, to represent their interests in deliveries on reparation account, as well as in ordinary sales of material to France and Belgium, made by the interested firms. Herr K. Witthauer, of the Poege Electricity Company, of Chemnitz, has been elected manager of the company.

An International Rubber Exhibition.

There opens in Paris to-day (Friday) an International Exhibition of Rubber and Other Tropical Products, in which most of the principal rubber-producing countries are represented. The proceedings will include papers on the production, manufacture, and employment of rubber. The president of the exhibition is Lord Colwyn and the vice-president Sir Wyndham Dunstan.

American Enterprise in Poland.

The main points of an electrification scheme for Poland, involving an outlay of some £5,000,000, to be guaranteed by the Polish State National Economy Bank, have been agreed on in principle between the Polish Government and the representatives of the European and American Utilities Corporation. The machinery required will be imported from the United States. The American group is to obtain a long-term concession for the exploitation of the scheme, the final signature of which is expected shortly.—*Reuter* (Warsaw).

Our Foreign Electrical Trade.

The following were the values of imports and exports of electrical goods and machinery during December:—

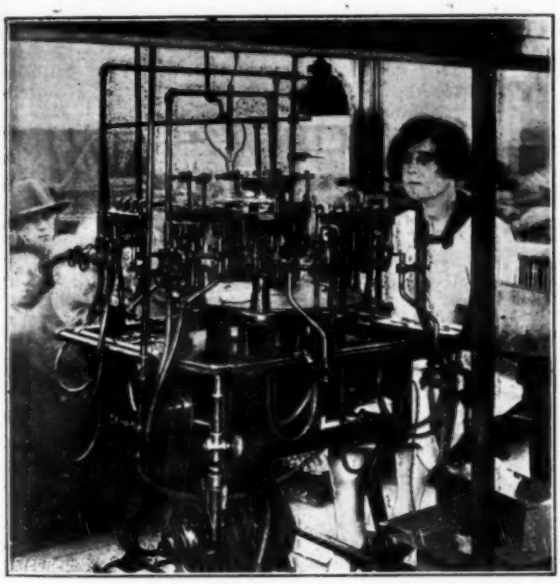
	December, 1926.	Inc. or dec.	12 months, 1926.
Imports—	£	£	£
Electrical goods and apparatus	395,079	– 16,647	– 490,965
Machinery	1,129,374	– 40,961	+ 839,222
(Electrical machinery)	145,790	+ 43,484	+ 68,222
Exports—			
Electrical goods and apparatus	1,022,706	+119,712	+ 582,025
Machinery	3,782,147	–554,956	–3,515,314
(Electrical machinery)	511,691	– 32,727	+ 54,739
Re-exports—			
Electrical goods and apparatus	21,289	+ 6,346	– 39,715
Machinery	121,383	– 47,878	– 200,493
(Electrical machinery)	7,698	– 107	– 14,911

Works Visit.

Forty-two members of the Association of Women Science Teachers paid a visit to the Osram Lamp Works, Hammersmith, on January 7th. The party was greatly interested in the various processes connected with the manufacture of "Osram" lamps and valves which were witnessed.

Valve-Making in a Showroom Window.

The movements of a machine fascinate the general run of people, and if the action is complicated the attraction is increased. It was therefore an excellent idea of the Edison Swan Electric Co., Ltd., to fix a valve-stem-making machine



Valve-making Publicly Demonstrated.

in one of the windows of its Queen Victoria Street showrooms. The process was one entering into the production of the company's "R.C.2" valves, which are being extensively advertised, and large cards were placed near the machine explaining the working of the machine. The result was that large crowds of people were attracted to the window all day long, and the interest thus aroused must have had the effect of impressing the company's name and its products upon the minds of these people.

A Receiver and a Power Company's Plant.

Mr. Justice Romer, in the Chancery Division on Wednesday, had before him an application by the Cleveland and Durham County Electric Power Co. in the debenture holders' action, Stewart *v.* Richardson, Duck & Co., Ltd., of Stockton-on-Tees, for a declaration that it was entitled to remove from the respondent company's premises a transformer and other electrical plant which it had installed there, in spite of the fact that a receiver of the company's assets had been appointed by the debenture holders.

The application was opposed by the receiver and the trustees for the debenture holders on the ground that the applicants were not entitled, under their agreement, to remove the plant until 16 years from the year 1915.

His LORDSHIP granted the application, but said it must be without prejudice to any obligation of the applicants to supply the respondent company with electricity.

Book Notices.

"Radio for the Million." Vol. 1, No. 1; pp. 48, illustrated, including diagrams and blue prints, and priced. London: Mullard Wireless Service Co., Ltd. Price 1s.—The aim of this quarterly publication, which is to be supplied free to the general public, is to provide those who have no knowledge of the technicalities of the subject with the essential constructional details of good-class receivers in a simple and understandable form. The importance of selecting the correct valves to use is stressed, for upkeep cost depends upon a wise choice, and full details of Mullard "PM" valves are included.

"Quarterly Review." January, 1927. London: John Murray. Price 7s. 6d.

"Post Office Electrical Engineers' *Journal*." Vol. LXIX. Part 4. January, 1927. London: The ELECTRICAL REVIEW. Ltd. Price, 1s. 6d. net.

"*Journal* of the Institution of Electrical Engineers." Vol. LXV. January, 1927. No. 361. London: E. & F. N. Spon, Ltd. Price, 10s. 6d.

Calendars and Diaries.

Once again we have to return thanks for the kind wishes of a number of friends and for calendars, &c. Among the latter is one from MESSRS. ROPER BROS., 5, South Anne Street, Dublin. This is an elliptical wall card with a block of daily slips; the national emblem is given prominence.

From MESSRS. SAULTERS PATENT COILING DEVICE, 240, Lower Road, S.E.8, we have received a wall calendar with monthly sheets and an illustration of the device which gives the firm its name.

The Lytham St. Annes Electricity Department has sent two different calendars. One, which is intended for private residences, is very ornate, and bears a reproduction of a river scene in colour. The other is for golf clubs, hotels, &c.; it has a matchbox holder, and depicts a caddy with a patch upon his trousers on which matches can be struck. Both calendars have monthly date slips.

MR. J. MARTIN BLAIR, of Amberley House, Norfolk Street, W.C.2, has sent us a porcelain "Midget" insulator, made in Holland, in the form of a paper weight, representing the little couplings so named.

For 1927 the D.P. BATTERY CO., LTD., of Bakewell, Derbyshire, has again prepared a large wall calendar bearing a charming view in colour of the Bakewell country. Monsal Dale is the choice on this occasion.

We have to thank the RELAY AUTOMATIC TELEPHONE CO., LTD., of Marconi House, London, for a very neat ash tray in insulating material.

Trade Announcements.

The BILLING TOOL CO. has removed to larger premises at 89, Great Eastern Street, E.C.2, where it has opened showrooms. (Telephone: Central 7036-3).

The LONDON ELECTRICAL CO., of 1, Sherborne Lane, E.C.4, and other addresses in London, desires it to be known that it is in no way connected with the firm bearing the same name and recently trading under that title at Cardiff, and mentioned in our "Bankruptcy Proceedings" section to-day as well as in our issue of January 7th.

The ACME ELECTRIC WIRE & CABLE CO., LTD., of Shardlow, has opened a depôt at 12, City Garden Row, City Road, London, N., where stocks of cables, flexibles, and bell wires will be held. Telephone No.: "Clerkenwell 3197."

It is announced that the goodwill and stock-in-trade of the electrical engineer's business carried on by the late Mr. William Cargill at 14-16, Hilltown, Dundee, under the firm name of W. Cargill & Co., has been sold to Mr. JAMES HACKNEY, electrical engineer, residing at 93, Cobden Street, Dundee. Mr. Hackney will continue the business at the same address under his own name. Mr. P. J. McIntyre, C.A., 20, Reform Street, Dundee, will attend to debts.

Electric Heating and Hardware, Ltd., of Birmingham, have appointed the "QUICKFIX" ELECTRICAL FITTINGS CO., LTD., of 47, Sauchiehall Street, Glasgow, C1, as agents for their "Komet" and "Glowincoal" productions in Scotland, and large stocks will be carried.

New Catalogues and Lists.

MESSRS. SPENCER (MELKSHAM), LTD., Melksham, Wilts.—A pamphlet dealing with the company's gravity shutes and conveyors.

The BILLING TOOL CO., 89, Great Eastern Street, E.C.2.—List No. 48, containing illustrations and prices of hand and machine tools.

THE MARCONIPHONE CO., LTD., 210-212, Tottenham Court Road, W.1.—A coloured poster and an illustrated and priced folder advertising "Marconi" valves. In the folder diagrams of typical receiving circuits are given.

MESSRS. HOUGHTON-BUTCHER (GT. BRITAIN), LTD., 88-89, High Holborn, W.C.1.—"Houghton's Radio News," containing notes on various radio components and accessories, as well as price and discount revisions.

AUTOMATIC & ELECTRIC FURNACES, LTD., 173-175, Farringdon Road, E.C.1.—Heat Treatment Bulletin No. 37, "Theory and Practice in the Hardening Shop," dealing with the use of Wild-Barfield electric furnaces.

MESSRS. HERBERT MORRIS, LTD., Loughborough.—A booklet illustrating and describing the "Morris" runway.

ENGINEERING AND LIGHTING EQUIPMENT CO., LTD., Sphere Works, St. Albans.—Catalogue No. 8, a well-illustrated list of industrial lighting fittings of many patterns for street lighting, docks and wharves, collieries, mills, &c. Full prices are given.

MESSRS. YOUNG & WILDSMITH, 20, Bloomsbury Street, W.C.1.—A list of "Association" radio valves of all makes, with details and prices.

KING'S SIGNS, LTD., 23, Collinwood Street, S.E.1.—A price list of advertising signs and brackets.

MESSRS. BAXTER & CAUNTER, LTD., 219, Tottenham Court Road, W.1.—List No. 39, containing illustrations, particulars and prices of domestic appliances, cables and wires, wiring materials, lighting fittings, violet-ray apparatus, &c.

MESSRS. HANS RENOLD, LTD., Didsbury, Manchester.—A January pocket-book blotter advertising standard chain drives.

THE BRITISH CENTRAL ELECTRICAL CO., LTD., 6 and 8, Rosebery Avenue, E.C.1.—An illustrated price list of switch- and fuse-gear, adaptors, plugs and sockets, flexible cords, cables, &c.

MESSRS. J. H. TAYLOR & Co., Macaulay Street, Huddersfield.—The "Reliability Wireless Guide," giving particulars and prices of all kinds of radio apparatus.

PHILIPS LAMPS, LTD., 145, Charing Cross Road, W.C.2.—Leaflet No. 77, describing the "Philips" rectifier for radio battery charging; and Leaflet No. 78, dealing with a h.t. supply unit for working off a.c. mains. Both are priced.

THE EQUIPMENT AND ENGINEERING CO., 2 and 3, Norfolk Street, Strand, W.C.2.—A brochure containing illustrations of the company's destination indicators and accessories fitted to omnibuses in various parts of the country, as well as pictures of the equipment itself.

MESSRS. WILLIAM C. JONES, LTD., Collyhurst Waste Mills, Manchester.—An illustrated brochure describing the production and packing of "Jonex" cotton waste. Also a sample in a cellophane wrapping.

Bankruptcy Proceedings.

COMTON WIRELESS MANUFACTURING CO. (A. P. Pacifico, J. P. Pacifico, and R. Feitelson), 26-28, Bartholomew Square, E.C.—This firm failed last June, and an application for an order of discharge was made last week to Mr. Registrar Mellor at the London Bankruptcy Court by the bankrupt Feitelson. The Official Receiver reported that the provable claims amounted to £2,552; the assets, valued at £1,830, had realised £332; and a dividend of 1s. 6d. in the £ was expected to be paid. The failure was attributed to the trade slump; heavy depreciation in the value of stocks; to general trade depression following the general and coal strikes, and to other causes. The application was opposed by the Official Receiver on statutory grounds. His Honour granted a discharge subject to judgment for £5 to be satisfied by an immediate cash payment.

N. H. PAYNE, 4, The Triangle, Teignmouth, late 11, Queen Street, Dawlish, electrical and radio engineer.—The public examination of this debtor was held on January 13th, at Exeter. The statement of affairs showed ranking liabilities of £798, against assets of £560. Debtor attributed his failure to his having no free capital to enable him to tide over the period of long term credit he had to give customers, and to his liabilities being considerably increased by creditors suing. He stated that he commenced business in 1925 without capital. He had never prepared any balance sheet to ascertain his position. He had borrowed from relatives, and had been sued by 24 creditors since March. The examination was closed.

A. A. WILLIAMS, 22, Elgin Mansions, Maida Vale, N.W.—The public examination of this debtor took place last week, before Mr. Registrar Mellor, at the London Bankruptcy Court, the accounts showing liabilities £1,328, against assets valued at £6. The debtor stated that in February, 1923, he was associated in the formation of a company styled "Radio Phonopore and Electricals, Ltd.," the nominal capital of which was £5,000, divided into 5,000 ordinary shares of £1 each, of which he subscribed for 1,000 shares. He was appointed joint managing director of the company, which, however, was considerably embarrassed through lack of sufficient working capital, and in January, 1926, he and his co-directors had recourse to a professional moneylender, from whom they borrowed the sum of £1,000 on their joint and several promissory note for £1,300; the whole of the principal was used in, and for the purpose of, the company, and he personally received no consideration. The company defaulted in the first repayment instalment to the moneylender, and in May, 1926, judgment was given against him and his co-directors jointly in respect of their liability. The company went into liquidation in June, 1926, and shortly afterwards these bankruptcy proceedings were initiated at the instance of the aforesaid moneylender. The debtor attributed his insolvency entirely to this liability. The examination was concluded.

G. MELLOR, electricians' agent, 59, New Oxford Street, W.—This bankrupt applied to Mr. Registrar Francke, at the London Bankruptcy Court on January 14th, for an order of discharge. The Official Receiver reported that the applicant failed in April, 1926, with liabilities of £450, and assets of £8. He commenced business in November, 1924, as an agent for manufacturers of wireless apparatus, and traded at Vernon House, Sicilian Avenue, W.C., under the style of "Mellors." Although he had no capital he did a very good business for a time in radio crystals, but closed down in August, 1925. His Honour granted a discharge, subject to judgment for £100, to be satisfied out of the applicant's future earnings.

D. T. DONOVAN and H. A. LANGLOIS, trading as the London Electrical Co., 119, St. Mary Street, Cardiff, late 124, Queen Street, Cardiff.—The first meeting of creditors was held on January 7th, at 34, Park Place, Cardiff. The statement of affairs had been lodged, and the matter was left with the Official Receiver as trustee of the estate.

W. K. COXON (separate estate) (trading with E. R. Weare as the Western Mfg. Co.), wireless apparatus manufacturer, Nurshill, Lydney.—Last day for proofs for dividend, January 28th. Trustee, Mr. C. Latham, 78, New Oxford Street, W.C.1.

E. D. S. MUNDAY, electrical engineer, 272, Lake Road, Portsmouth.—Last day for proofs for dividend, January 29th. Trustee, Mr. H. Ashton, Official Receiver, 87, High Street, Portsmouth.

G. W. TEMPEST (Northern Radio Co. and General Wireless Trading Co.), radio and telephone engineer, 40, Brazennose Street, Manchester.—Last day for proofs for dividend, January 24th. Trustee, Mr. A. Yearsley, 37, Brazennose Street, Manchester.

J. R. HEREFORD-LAVEY AND V. DE FRECE (Radio Cash Stores), 371, Upper Street, Islington, N., 5, New Station Street, Leeds, and Parliament Street, Nottingham.—Last day for proofs for dividend, January 28th. Trustee, Mr. C. Latham, 78, New Oxford Street, W.C.1.

H. L. WOOD, electrical engineer, late of Elm Grove, Southsea.—First and final dividend of 1½d. in the £, payable at the Official Receiver's Office, 87, High Street, Portsmouth.

H. E. PARRIS (St. George's Electrical Mfg. Co.), 134, Upper Thames Street, late of Sydenham.—Bankrupt discharged January 14th, 1927.

Company Liquidations.

KNIVETOWN ELECTRIC WIRE CO., LTD., electrical engineers and radio manufacturers, Queensway, Ponders End, Middlesex, and 32, Sun Street, E.C.2.—A meeting of creditors was held on January 10th at the Institute of Chartered Accountants, E.C. The chair was occupied by Mr. S. W. Tubbs, of Messrs. Dixon, Wilson, Tubbs & Co., C.A., 24, Basinghall Street, E.C., the liquidator of the company. The statement of affairs presented showed liabilities of £4,647, of which £3,387 was due to the trade, and Mr. H. C. Bayldon, one of the directors of the company, was a cash creditor for £1,260, having paid off the claim of the bank under his guarantee to them. The net assets were £4,537, leaving a deficiency so far as the creditors were concerned of £110. The preferential claims included an amount in respect of income tax, but having regard to the trading losses of the company, it was thought possible that the claim might be withdrawn. The stock had only been written down by 20 per cent., as there was a possibility of a sale as a going concern taking place. The plant and machinery had been written down by about £600; it was comparatively new. The issued capital of the company was £8,386, and as regarded the shareholders, there was a deficiency of £8,496. The company was registered on April 9th, 1925, with a nominal capital of £1,000, and Messrs. Frank and Harold Kniveton were appointed life directors. The company rented a factory at Enfield, and equipped it. The capital was increased to £2,000 on May 14th, 1925, the additional £1,000 being subscribed in cash. In June, 1925, Messrs. Arthur and Samuel Jones were appointed directors of the company, but retired the following September, when Engineer-Commander W. H. Waters and Mr. H. C. Bayldon were appointed to fill the vacancies. In October, 1925, the share capital was increased to £8,000. On April 13th, 1926, Mr. G. H. Wilkinson, jun., became a director, and subscribed in cash for 1,000 shares, but he resigned in the same month. A little later the company's capital was increased to £10,000. Offices and stores at Sun Street were opened in June, 1926, for the purpose of carrying on the business of wholesale dealers in the products of the company. Mr. H. Kniveton was appointed the branch manager. Mr. Tubbs stated that the company had suffered from lack of capital. During the year ended March 31st, 1926, the turnover was £9,006, with a gross profit of £539, and a net loss of £1,106. Between April 1st and December 20th last the turnover increased, the sales being £9,184, but there was a net loss of £3,879. Owing to the loss on the trading, Messrs. F. and H. Kniveton agreed to forego the greater part of their remuneration for the year, amounting to an aggregate of £800. The heavy losses sustained were apparently due to incorrect costing, and the expenses of administration. There were two or three works' managers, or gentlemen who occupied a corresponding position, for a turnover of only £9,000 a year. Last November and December matters were brought to a head by several of the larger creditors commencing proceedings, and it was then decided that the company should go into voluntary liquidation. A creditor said that the preliminary expenses appeared rather heavy, and the chairman replied that shares to the value of £800 each were voted to Messrs. Kniveton, and that

accounted for £1,600. Some of those shares were subsequently sold for cash, and the money went to the company. Mr. Kniveton said that during 1925 and 1926 the sales of radio goods were extremely low at certain periods. Then the company had rush orders, which had to be executed. In the lean times they were obliged to keep on the workers, although there was not sufficient work for them. The result was that at periods large amounts had to be paid in wages, and there was not an adequate return. The prices which the company had obtained for its goods, and the allowances made, were the highest possible in the trade. A suggestion was made that another liquidator should be appointed, but this was not agreed to, and a resolution was passed confirming the appointment of Mr. Tubbs as the liquidator, whilst a committee of the principal creditors was also nominated. The following are creditors:—

	£		£
Ariadne Draht-und Kabel-Werke	575	Guido Horn	114
Albion Sewing Cotton Co., Ltd.	503	Turner Bros. Asbestos Co., Ltd.	77
Mather, Ormesher & Co., Ltd.	385	Johns, Son & Watts, Ltd.	71
McConnel & Co., Ltd. ...	200	Booth & Co., Ltd. ...	70
Charlesworth, Peebles and Co.	182	Ormerod Bros., Ltd. ...	62
Blades, East & Blades, Ltd.	136	General Electric Co., Ltd.	53

AUTOMATIC COMPANY (BRISTOL), LTD., electric sign manufacturers, Broad Quay, Bristol.—A meeting of creditors was held recently at the offices of Messrs. Cozens, Bate & Co., Baldwin Street, Bristol. Mr. W. L. Bate, the liquidator in the voluntary liquidation of the company, submitted a statement of affairs, which showed liabilities of £852, all of which were due to the trade. The assets were estimated to realise £643, leaving a deficiency so far as the creditors were concerned of £208. The company was registered in August, 1923, with a nominal capital of £3,000, of which £2,550 had been issued and was fully paid. Between August, 1923, and December, 1924, there was a loss of £67 on the trading, but in 1925 a profit of £68 was earned. The creditors passed a resolution confirming the voluntary liquidation of the company, with Mr. Bate as liquidator, whilst a committee was also appointed consisting of the representatives of Messrs. Dunn & Co., Pinchin, Johnson & Co., and T. Reynolds and Son. The following are creditors:—

	£		£
Ackroyd & Best, Ltd. ...	74	Reynolds, T., & Sons ...	35
Chappell & Co., Ltd. ...	31	Russian Oil Products, Ltd.	22
Dunn & Co.	125	Simpson, Baker & Co....	33
General Electric Co., Ltd.	33	Cook, N. F., & Son ...	40
General Tyre Co. ...	21	Protection Lamp and Lighting Co.	102
Pinchin, Johnson & Co., Ltd.	61		

SLOGASIGNS, LTD., 51, Bethnal Green Road, E.—The first meetings of creditors and shareholders were held last week at Carey Street, W.C., before Mr. E. T. A. Phillips, Official Receiver. A statement of affairs was presented showing liabilities of £1,594, against assets valued at £476, and a deficiency of £6,117 with regard to contributories, the issued capital being £5,000. The chairman reported that the winding up order was made on November 9th, 1926. The failure was attributed to insufficient capital; the necessity for further experiments with the devices instead of being able to put them straight on the market as was anticipated; and to the restrictions put by the Government on the use of electricity owing to the general and coal strikes. The liquidation was left in the hands of the Official Receiver.

DOMESTIC & GENERAL ELECTRICAL CO., LTD.—A meeting of members is called for February 18th, at the offices of Messrs. Corfield & Cripwell, Balfour House, Finsbury Pavement, E.C., to hear an account of the winding up from the liquidator, Mr. W. A. J. Osborne.

BUCKS ELECTRIC WIRE & ENGINEERING CO., LTD.—A meeting of members is called for February 18th, at the offices of Messrs. Corfield & Cripwell, Balfour House, Finsbury Pavement, E.C., to hear an account of the winding up from the liquidator, Mr. W. A. J. Osborne.

COMPRESSION STARTER & SWITCHGEAR CO., LTD.—A meeting of members is called for February 14th, at the offices of the British B.A.G., Ltd., Ormes Buildings, Parsonage, Manchester, to hear an account of the winding up from the liquidator, Mr. J. Abson.

Private Arrangements.

CLEARTRON RADIO, LTD., 1, Charing Cross, S.W.—A meeting of the principal creditors was held recently at the company's offices, when a statement was made by one of the directors. It appeared that the company had an issued capital of £55,000, and last year negotiations were entered into with the object of raising additional capital to the extent of £100,000, in order to extend and consolidate the business, but the matter fell through. There was an overdraft at the bank, and debentures for £30,000 were created. With that money the bank was paid off, and the balance was utilised in discharging pressing debts. One or two creditors had commenced proceedings, and if judgment was obtained, the debenture holders might appoint a receiver. Since November, fresh negotiations had been commenced with a view to raising further capital, and it had been decided to call the principal creditors together in order to ask them to refrain from taking steps against the company, as it was believed that the negotiations could be carried through and the business continued successfully. The principal creditors decided to recommend the creditors generally to hold their hands for the time being. It was also decided that the meeting should be adjourned, and it was hoped by the time of the adjourned meeting that the negotiations would be carried to a successful issue. It was also suggested that Mr. Bertram Day, a large creditor, should be appointed to the board. The suing creditors would be asked to stay their hands. The liabilities, apart from the debentures, were stated to be about £30,000.

Dissolution of Partnership.

DEESIDE RADIO SERVICE, wireless instrument makers, 33, Grange Road, West Kirby, Chester.—Mr. J. L. Bull and Mr. K. W. Pardoe have dissolved partnership. Mr. Bull will attend to debts and continue the business.

Trade Mark Applications.

The following are among the recent applications for British trade marks. Objections against any of the proposed marks may be lodged within one month from January 12th:—

Octron. No. 475,558. All goods in Class 6. No. 475,559. All goods in Class 13. No. 475,560. All goods in Class 18.—H.S. Electric, Ltd., 32, Charles Street, Birmingham.

Contax.—No. 469,382. Class 8. Telemeters, searchlights, &c.—Contessa-Nettel Gesellschaft, Stuttgart. (British representatives: Marks & Clerk, 57-58, Lincoln's Inn Fields, W.C.2.)

Sifam. No. 473,522. All goods in Class 8.—Sifam Electrical Instrument Co., 95, Queen Victoria Street, E.C.4.

Herculene. No. 475,891. Class 8. Electric cables.—W. T. Henley's Telegraph Works Co., Ltd.

Social Events.

The Committee of the G.E.C. Social and Athletic Club was "At Home" to the junior members of the staff at Magnet House on the evening of January 7th, when 150 members were entertained. Dancing, games and conjuring contributed towards a most pleasant evening. Sir Hugo Hirst, the president of the club, who was accompanied by Mr. L. C. Gamage (the chairman) and Mrs. Gamage, addressed those present. Mrs. Gamage presented and distributed prizes to the best dancers in a special competition.

The Magnet Club of Fraser & Chalmers Engineering Works, Erith, held its third dance of the season in the Belvedere Public Hall on January 8th, in which over 100 members of the club and their friends took part. Special "G.E.C." lighting effects, combined with the decorations, added to the enjoyment of the evening.

The annual dinner of the Willesden Polytechnic Electrical Engineering Society will be held on Saturday, February 12th (the 25th anniversary of the Society's formation), at the Café Marguerite, Oxford Street, the president, Mr. Frederic H. Taylor, A.M.I.E.E., A.M.I.Mech.E., in the chair. Old members of the Society should apply for tickets to Mr. T. Bowen, the hon. sec.

Mr. Arthur Cozens, registered electrical contractor, of Ascot, Camberley, Clacton, and Henley, again entertained his staff and friends of the firm at a New Year's party and dance at the Cordes Hall, Sunninghill, on January 7th, over two hundred being present. Dancing commenced at 7.30 and was followed by an entertainment excellently rendered by the Cozens Co-Pessimists. Songs, monologues, &c., were given by Messrs. G. Hyde, A. E. Godden, M. Adams, G. Ross, E. Sales, J. Beckwith, and Barry Cozens. Mrs. Bailey's band provided the dance music. During an interval Mrs. Cozens was presented with a bouquet of carnations.

The concluding portion of the first annual sales conference of the Pirelli-General Cable Works, Ltd., was held at the Royal Pier Pavilion, Southampton, on the 7th inst., and the directors of the company invited the members of the staff and their wives to a supper dance. About 250 people were present, and a most enjoyable evening was spent.

The annual carnival and dance of the staff of Messrs. Johnson and Phillips, Ltd., was held at the Blackheath Concert Hall on January 7th. The attendance exceeded 450 and included Sir Philip Dawson, M.P., Mr. J. Macgregor and Mr. C. Stewart, directors of the company. The costumes were judged by Miss Annie Croft and Mr. Reginald Sharland, of the Shaftesbury Theatre, and the prizes were presented to the winners by Lady Dawson, Mrs. Macgregor and Mrs. Stewart. These prizes were the gift of Mr. H. L. Duwe (South African representative), the provincial branch managers, and Mr. E. P. Weston.

Railway Rates Increase.

According to the Federation of British Industries, the increased rates upon railway goods traffic, mentioned in our last issue, are to come into force on February 1st.

Meter Approved.

The Electricity Commissioners have approved the "Rex" single-phase, type "SIP.1a," induction watt-hour meter (sizes 2.5 to 100 A, 110 to 240 V, at 50 cycles), for which Messrs. THOMPSON & Co., 1, Old Swan Lane, E.C.4, are sole British agents.

Colchester Joins Joint Board.

The Colchester Council has agreed to join the District Joint Board of Employers and Members of Staff (No. 9 area).

A Petters' Indian Award.

Messrs. Petters, Ltd., inform us that their agents for the Bombay Presidency, Messrs. Turner, Hoare & Co., Ltd., were awarded a gold medal at an Agricultural Show held at Poona in October last. This was in respect of a portable chain-driven pumping plant, comprising an 8-b.h.p. "Petter" crude-oil engine and a "Pulsometer" 6-in. centrifugal pump, mounted on a trolley. The Show is said to have been the largest ever held in Asia.

For Sale.

Lytham St. Annes Electricity Department has for disposal surplus generating plant. (See our advertisement pages to-day.)

The Contractors' Dinner.

The annual dinner of the Electrical Contractors' Association and Allied Associations was held at the Trocadero, W., on Tuesday last. The president, Mr. H. J. Miles, was in the chair, and the principal guest was Col. Wilfrid Ashley, the Minister of Transport. The speakers included Sir Hugo Hirst, Bt., and Messrs. P. J. Hannon, M.P., T. E. Alger, R. W. L. Phillips, W. R. Rawlings, J. Y. Fletcher, and H. J. Galliers. A report of the proceedings will appear in our next issue.

The Progress of British Electrical Industry.

At the end of last week several daily papers published statements which had been issued by the British Electrical and Allied Manufacturers' Association regarding the excellent record of the British electrical industry in 1926. As quoted by the *Daily Telegraph*, it appears that in spite of the severe industrial crisis which reigned throughout the last eight months of the year as a result of the coal stoppage, the electrical industry had a record year both at home and abroad. "All branches of production, with the exception of the industrial motor section, have been working full time; thousands of new employés have been engaged to cope with the increased demand, and the leading firms now report that they have work on hand sufficient to last for fifteen months. The orders received for generating plant on home account, due to the new super-power stations being erected in London, Coventry, Bristol, Oldham, Birmingham, and Kearsley in preparation for the national power scheme, were 24 per cent. higher than in 1925 and only 6 per cent. below 1920. On export account the increase over 1925 was 22 per cent., and over 1920 43 per cent., while, for the entire range of business, 1926 was 10 per cent. above all previous records. Britain has become the world's leading supplier of electrical goods, and, in the face of the most intense competition from Germany, the United States and Switzerland, obtained important contracts in 1926, totalling over £20,000,000 in the Dominions, especially India, Australia, New Zealand, and South Africa, in Brazil, Argentina, Japan, China, Norway, Sweden, Poland, France, Italy, Russia, Belgium, Spain, Holland, Denmark, Mexico, Chile, and the United States. Railway electrification, water-power schemes, giant power stations, transmission systems, and industrial electrification formed the bulk of overseas demand, many of the contracts secured being on a scale unparalleled in in the history of the industry. British electrical engineers are active now in almost every country of the world, developing power resources and consolidating everywhere the British reputation for high-quality production and sound design. Export shipments totalled £18,194,000 in 1926, an increase of £630,000 over the previous record year of 1925, and there are indications that 1927 should establish the £20,000,000 level. In electrical machinery the competitive position of the British electrical industry is higher now than at any previous time, and new markets are being opened every year for the British product."

Prices of Materials.

With reference to the lead position, Messrs. James Forster and Co. report, under date January 15th:—"A better demand from consumers, particularly for early delivery, has been experienced this week, which accounts for the firmer tone in evidence in the market."

The Board of Trade returns for December, 1926, are:—Imports 28,504 tons, exports 1,169 tons, left for home consumption 27,335 tons.

Messrs. F. Smith & Co. report, January 18th:—Copper (electrolytic) bars, £63, 10s. inc.; ditto ditto sheets, no change; ditto ditto wire rods, £73, 35s. dec.; ditto ditto h.c. wire, 9 3/16d., 1/16d. inc.

Messrs. James & Shakespeare report, January 18th:—Copper bars (best selected), sheet, and rod, £90, £2 dec.; English pig lead, no change.

Messrs. Edward Till & Co. report, January 18th:—India-rubber, Para fine, 1s. 5d., ¼d. inc.

Recent Contracts.

The METROPOLITAN-VICKERS ELECTRICAL CO., LTD., has received from Spain an order for one hundred and four 230-h.p. motors for motor coaches which are required in connection with an important electrification scheme for two main-line sections of the Norte Railway near Barcelona. The first sections of line to be electrified are from Barcelona to Manresa, a distance of 64 km., and from Barcelona to San Juan de las Abadesa, a distance of 106 km. The system adopted is 1,500 V d.c., with overhead conductor. The passenger stock arranged for comprises 26 train units, each unit consisting of one motor coach and one trailer coach, providing seating accommodation for about 200 people. The mechanical parts for the coaches will be manufactured by the Sociedad Española de Construcción Naval, which is associated with the Metropolitan-Vickers Company, at its Bilbao works. Each motor coach will be equipped with four 230-h.p. motors of the M.-V. self-ventilated series-wound type, each pair of motors being connected permanently in series on the 1,500-V supply. The field system of the motors is arranged for weak-field control, thus giving additional economical running notches on the controller. The trains will operate at an average schedule speed of 32 m.p.h., and will be capable of a maximum speed of 56 m.p.h.

The ELECTRIC FURNACE CO., LTD., 17, Victoria Street, S.W.1, which controls the patent rights, is supplying to Messrs. Edgar Allen & Co., Ltd., Sheffield, an Ajax-Northrup high-frequency furnace for the manufacture of special steel. The furnace, which will be of about 3 cwt. capacity, will be operated by a 150-kW high-frequency motor-generator. This plant is of interest as being the first high-frequency furnace for commercial steel making in this country. Messrs. Edgar Allen & Co. were the first British company to install an electric arc furnace for commercial steel making, a Héroult furnace erected in 1909.

MESSRS. SIEMENS BROS. & CO., LTD., of Woolwich, have received orders valued at £200,000 for automatic telephone exchanges in the Brisbane area for the Commonwealth of Australia (P.M.G.'s Dept.), concerning which we give some particulars in a leaderette to-day.

We learn that the Peking Chinese Electric Light and Power Co., Ltd. (a purely Chinese company, in which there is no foreign capital), has placed an order with the METROPOLITAN-VICKERS ELECTRICAL CO., LTD., for a 10,000-kW turbo-generator.

Reuter's Trade Service reports that the English Electric Co. of Canada has secured a contract for the complete electrification of the Noranda mines.

Unemployment.

The Employment Exchange returns dated January 3rd showed a total of 1,495,000 persons who were totally unemployed. This was 144,755 more than on December 24th and 244,094 more than on January 4th, 1926.

Irish Free State Electrical Imports.

The imports of electrical goods, excluding machinery, into the Irish Free State during November last amounted to a value of £39,591, as compared with £48,166 in the corresponding month of 1925.

Electric Locomotives for Spain.

The North of Spain Railway Co. has ordered 22 electric locomotives from the Euskalduna concern. An important part of each of these engines will be manufactured in Switzerland.—*Reuter's Trade Service* (Madrid).

New Italian Companies.

Among the concerns recently organised in Italy are the Società Officine Elettrotechniche e Meccaniche, of Milan, capital 2½ million lire; La Società "Isolo" Fabbrica Isolanti Elettrici Sterlingati, Milan, capital 25,000 lire; La Società Industria Apparecchi Termo-Elettro Sanitari, Milan, capital 30,000 lire; and La Società Forze Idrauliche Alta Maira, Rome, capital 500,000 lire.

The Signs of Trade Revival.

In the article bearing the above heading in our last issue a sentence in the third paragraph—"Unhappily the restlessness of China, Russia, and Mexico are still features in the situation"—should have appeared at the end of the paragraph, as our readers will have seen. The sentence was misplaced during proof correction.

More Birmingham Exhibitors.

We inadvertently omitted MESSRS. EARLE, POURNE & CO., LTD., and MESSRS. HOLLINGS & GUEST, LTD., from our last week's list of exhibitors in the British Industries Fair. In their capacity of metal and tube producers, Messrs. Earle, Bourne are closely connected with the electrical industry; and the machinery made by Messrs. Hollings & Guest is of special interest to the electrical trades.

Registered Electrical Contractors.

At a meeting of the Executive of the National Register of Installation Contractors, on January 14th, applications by the following for registration were approved:—

Savage, Thomas A., London, W.3.
Winship, William P., South Shields.
Dagleas, James T., South Shields.
Electric Wiring and Repair Co., Cambridge.
Fryer & Howarth, Rochdale.
Gatley & Co., Todmorden.
Velox Tool Manufacturing, Electrical and Wireless Engineering Co., Newcastle-on-Tyne.
Ross, David, Newcastle-on-Tyne.
Deal and Sandwich Electrical Co., Ltd., Deal.
Walker & Co., Smethwick, Birmingham.
Wright, T., & Co., Leicester.

At the same meeting one application was withdrawn and four were declined.

Lighting and Power Notes.

Australia.—TASMANIA.—The transmission line from Waddamanna to Railton, the erection of which has been carried out by Messrs. Armstrong, Whitworth, Ltd., has been completed, and secondary distribution feeders to supply different services on the North-West coast are nearing completion. Satisfactory progress has also been made with the erection of an 88,000-V sub-station at Railton. It is expected that the whole service will be in operation shortly. It will supply electricity to Sheffield, Railton, Devonport, Ulverstone, and Penguin, in addition to the cement works at Railton and the shale oil works at Latrobe.—*Reuter's Trade Service* (Melbourne).

Barnsley.—EXTENSION OF SUPPLY.—The Electricity Committee is to borrow £1,634 for the extension of its electricity supply to Monk Bretton.

Barrow.—ELECTRICITY SCHEME.—The Town Council has decided to make no further application to the Electricity Commissioners for sanction to proceed with the Backbarrow hydro-electric scheme, but has decided to request them to approve of extensions at the existing station by increasing the capacity by 6,000 kW. The cost of this scheme is estimated at £60,000.

Bradford.—ELECTRICITY SCHEME.—It is reported that the Corporation is to proceed with a scheme of extensions to its electricity undertaking, involving a capital expenditure of £300,000. It is proposed to enlarge the present Valley Road works and to erect a boiler-house which will contain extra-high-pressure boiler plant with a pressure of 1,100 lb. per square inch. The pressure employed in this installation will be the third highest in the world, one at Milwaukee having a pressure of 1,400 lb., and another (at Boston, New York) having a pressure of 1,200 lb. per square inch. The estimated cost of this section of the scheme is £80,000, and it is estimated that a saving of 12 per cent. of coal will be made. The Electricity Commissioners have already sanctioned a scheme which includes provision of a 20,000-kW set, and the whole of the scheme will cost approximately £300,000.

Bridge of Allan.—TRANSFER OF ORDER.—The Town Council is to make application to the Electricity Commissioners for sanction to transfer the Bridge of Allan Electricity Special Order, 1925, to the Scottish Central Electric Power Co.

Canada.—MANITOBA.—The third set of 29,000 h.p. at the Great Falls plant of the Manitoba Power Co. on the Winnipeg river was put into commission recently, bringing the capacity of the station up to 84,000 h.p. The ultimate capacity of the station will be 168,000 h.p., and the fourth set is on order and is expected to be in service by August next.

Cockermouth.—ELECTRICITY SUPPLY.—The Urban District Council on January 5th decided to appoint a committee to go into the question of providing an electricity supply for the town.

Continental.—BELGIUM.—A new power station is being established at Moli by the Société d'Electricité de la Campine. The plant will comprise two 10,000-kW turbo-generators, supplied by the Ateliers de Constructions Electriques de Charleroi, and Brown Boveri & Co., of Baden, Switzerland.

FRANCE.—The Compagnie d'Electricité Industrielle, of Paris, has recently secured a concession to establish a hydro-electric plant to utilise the water power of the River Pique near Saint Aventin in the Upper Garonne Department.

Dewsbury.—ELECTRICITY EXTENSIONS.—The Electricity Committee has authorised the expenditure of £8,000 for extension of the h.p. main from the generating station to various districts. The scheme involves the erection of four sub-stations.

Douglas (I.O.M.).—NEW STORAGE BATTERY.—Owing to delay in proceeding with the scheme of extension it will be impossible to have the new plant completed for next season's load, and in the circumstances the Committee has decided to duplicate the existing storage battery at an estimated cost of £4,000.

Eastbourne.—LOAN SANCTION.—*Correction.*—The amount recently sanctioned for sub-station buildings was £250, being an outstanding balance, and not £52,671 as stated in the Finance Committee's report and quoted by us in our last issue.

East Dereham.—PROPOSED BULK SUPPLY.—The Urban District Council has received an offer of a bulk supply of electricity from Norwich Corporation. The cost of an overhead transmission line would be £8,500, and electricity would be transmitted to Dereham at a pressure of 11,000 V. The charge to the Council would be £4 10s. per kW of maximum demand, plus .71d. per kWh for electricity taken. The Council has referred the matter to its electrical expert for advice.

Eastry.—ELECTRICITY SUPPLY.—The Rural District Council has decided to offer no objection to the Order of the South-Eastern Electric Power Co., for the supply of electricity in the area, but the company has been requested to lay cables underground wherever possible when crossing highways.

Edinburgh.—APPLICATION FOR ORDER.—The Corporation recently approved a recommendation of the Electricity and Lord Provost's Committees to promote an Order for powers to construct outlet pipes from the electricity station and a pier at Portobello, and for other purposes. The estimated cost of outlet pipes and pier combined is £60,000.

PRICE INCREASE.—The Electricity Committee has announced that, in consequence of the increase in the cost of coal, there will be an increase in the price of electricity for lighting from 4d. to 4½d. per kWh as from the beginning of the spring term.

Hatton (near Warwick).—INSTITUTION SUPPLY.—New heating and lighting services are to be installed at the Warwickshire Mental Home, at an estimated cost of £35,638.

Hastings.—LOANS SANCTIONED.—The Corporation Electricity Committee has received sanction to the borrowing of £7,000 for services and £1,000 for transformers and sub-station equipment.

Hereford.—LOAN SANCTIONED.—The Town Council has received sanction to a loan of £6,000 for electricity purposes.

Huntingdon.—ELECTRICITY SUPPLY.—The Bedfordshire, Cambridgeshire and Huntingdonshire Electricity Co. has informed the Town Council that, owing to the action of the Government, it is unable to proceed with the provision of the station at St. Neots as proposed, but it is hoped to provide a supply of electricity for Huntingdon and Godmanchester in eight months' time.

Irish Free State.—DUBLIN.—The City Commissioners have adopted a recommendation to reduce the charge for general heating from 2½d. to 2d. per kWh. Other reductions and modifications, principally in connection with special classes of supplies, will be put into operation as from the beginning of the last (December) quarter.

ENNISCORTHY (Co. WEXFORD).—The Urban District Council's electricity undertaking is to be formally inaugurated on February 3rd.

Keighley.—LOANS SANCTIONED.—The Town Council has received sanction to the borrowing of £8,095 for mains and £3,011 in connection with the main transmission line from the generating station to the Bingley Urban District Council's distribution station.

Loughborough.—EXTENSION OF SUPPLY.—At a recent meeting of the Town Council a proposal to withdraw an application for sanction to the borrowing of £3,850 and to substitute a more comprehensive scheme for a supply of electricity to Nanpantan was considered. The new scheme involves the raising of a loan of £5,802, and includes the erection of a sub-station and the laying of underground mains to Nanpantan. The matter was referred to the General Purposes Committee.

Luton.—LOAN.—The Town Council has applied for sanction to a loan of £26,636 for supplying electricity to villages near the borough. There have been 178 applications for electricity from the area in question.

Newhaven. — ELECTRICITY SUPPLY. — The Rural District Council has been informed by the Electricity Commissioners that the Peacehaven Electric Light and Power Co., Ltd., has asked that the Council's consent should be dispensed with in connection with an application to supply electricity to the parishes of Piddinghoe and Telscombe. As the Piddinghoe Parish Council has decided in favour of the Order, the Council has withdrawn its objection in respect of that parish, but adheres to its objection regarding the parish of Telscombe, and has asked the Commissioners to hold a public inquiry into the matter.

North-West Midlands Electricity District.—TRANSFER OF UNDERTAKINGS.—At a recent meeting of the Stafford Town Council, a report submitted by the Electricity Committee with regard to the question of the transfer of generating stations by the authorised undertakers in the North-West Midlands Electricity District and the establishment of a Joint Electricity Authority for that district was considered. The Committee stated that it had given careful consideration to proposals contained in a report of a conference of the authorised undertakers, and recommended the adoption of the principles contained in the report, subject to the following reservations: (a) That an independent audit be made of each undertaker's capital accounts, which are to form the basis of calculation for the consideration for the transfer of generating stations. (*b*) That the basis upon which the transfer of stations should be made in each case should be the original capital cost, less an amount in respect of depreciation, to be determined at one uniform rate for all buildings to be transferred, and another uniform rate for all plant and machinery to be transferred, without regard to any outstanding liabilities in respect of either building or plant.

Portsmouth.—NEW TURBINE HOUSE.—The foundation stone of the new turbine house at the Corporation power station was laid by the Mayor on January 12th. The new building will house two 10,000-kW sets, and the total cost of the scheme will be approximately £70,000.

ELECTRICITY SUPPLY.—The Electricity Committee is to carry out extensions at the generating station at a cost of £1,700, to extend the mains in the Waterlooville area at a cost of £1,000, and to erect a sub-station near Prospect Road, the cost being estimated at £1,000.

Pwllheli.—INAUGURATION OF SUPPLY.—An electricity supply for the district was formally inaugurated by the Mayoress on January 15th. Electricity is supplied by the Electricity Distribution of North Wales and District, Ltd.

Rugeley. — ELECTRICITY SUPPLY. — The Urban District Council has approved of the draft agreement with the Power Development Co. for a supply of electricity to the district within 2¼ years of the granting of the Order.

St. Austell (Cornwall).—ELECTRICITY SUPPLY.—Owing to the disappointment expressed by residents that a supply of electricity should thus be vetoed, the Rural District Council on January 7th rescinded the resolution which it passed recently refusing permission to the St. Austell and District Electric Lighting and Power Co., Ltd., to erect overhead lines in connection with an electricity scheme for Tywardreath and district.

Sheffield.—MAINS EXTENSIONS.—The Corporation Electric Supply Committee has approved extensions of mains, at an estimated cost of £28,227.

Slaithwaite (Yorks.).—LOAN.—The clerk to the Urban District Council reported recently that, in response to an application to borrow £3,150 for electricity extensions, the Electricity Commissioners had suggested that, as the Council would require £2,000 per year for normal extensions, the application should be increased to £7,250, which would cover the amount overspent to April 1st (£1,148), and leave £2,000 for each of the three following year's extensions, the sum of £6,250 being for mains and services and £1,000 for meters. Extensions made up to date had been greater than had been anticipated. The Council agreed to apply for a sum of £7,250.

South Durham.—SPECIAL ORDER.—Application has been made to the Electricity Commissioners by the Cleveland and Durham County Electric Power Co. to amend the draft of a Special Order so as to include certain parishes in the rural district of Darlington.

Spalding.—EXTENSION OF SUPPLY.—The Urban District Council is to apply for a Special Order to supply electricity to Crowland, Borough Fen, and Newborough. The estimated cost, with transformer, meters, and services, is £2,500.

Stoke-on-Trent.—RELAYING CABLES.—The Corporation Electricity Committee is to relay cables in Longton at a cost of £5,700. The Committee has decided that as the North-Western Electricity and Power-Gas Co. has not exercised any of the powers conferred upon it by its Act of 1903 in any portion of its area of supply within the North-West Midlands Electricity District, application shall be made to the Ministry of Transport for an Order annulling the powers of the company, so far as they affect that district.

Walsall.—ELECTRICITY EXTENSIONS.—The Town Council reports that in connection with the extension of Birchills power station, contracts for machinery, amounting to £140,721, have been placed.

Weymouth.—PRICE REDUCTIONS.—The Electricity Committee has reduced the electricity charges by ½d. per kWh, and hopes to effect a further reduction before next quarter.

Tramway and Railway Notes.

Australia.—SYDNEY.—Details of the new underground railways in Sydney and the electrification of the Sydney suburban railway system were given in a recent speech by the Assistant Commissioner of the New South Wales Railways. It had been found necessary, he said, to increase the width of the carriages and consequently to rearrange the tracks. This work, with the erection of overhead equipment and alteration of bridges to carry the overhead lines, was estimated to cost £15,000,000. Rolling stock for the electric services would cost £6,000,000, and the construction of the underground railways £7,000,000. In addition, £4,000,000 had to be paid towards the construction of the Sydney Harbour bridge.—*Reuter's Trade Service* (Melbourne).

Bradford.—PASSENGER SIDINGS.—The Tramways Committee has approved the alteration of Leeds Road tramway terminus to provide passenger loading sidings in Hall Ings, at an estimated cost of £1,537.

Continental.—SWITZERLAND.—Work is in hand on the construction of an electrically-operated cable railway between Lake Trub and Gerschnialp, near Engelberg. The line is being constructed on the Bleichert system, the electrical part of the work being in the hands of the Bell Gesellschaft, of Kriens, Lucerne. The difference in altitude between the upper and lower stations is about 6,560 ft., which, it is expected, will be covered in 10 minutes.

GERMANY.—According to a statement recently issued by the German State Railway Exploitation Co., owing to the existing financial stringency it will not be possible at present to consider the electrification of the railway system in Baden.

FRANCE.—A new mercury-arc rectifier station has lately been brought into operation near the Louvre, Paris, to supply the Nos. 1 to 7 lines of the Paris underground railways. The station, which has a capacity of 3,600 kW, comprises four rectifier-transformer sets of the Brown-Boveri mercury-vapour type, each capable of supplying 1,500 amps. at 600 V. The Compagnie Electro-Mécanique, of Paris, which has carried out the installation, has previously completed one at "La Nation" station, and is at work on a third transformer plant at the Saint Antoine station.

JUGO-SLAVIA.—It is reported from Belgrade that the Municipal Council proposes to extend the tramway network, enlarge the central generating station, and construct water mains, &c. Consideration is being given to an offer of credit of from $15,000,000 to $20,000,000, which is said to have been made by American circles for these purposes.

United States.—RAILWAY ELECTRIFICATION.—According to the *Tramway and Railway World*, work is in hand on an electrification scheme on the Great Northern Railway. The present undertaking involves the revision of the original electrification between Tye, Washington, at the western end of the Cascade Tunnel and the eastern portal of the same tunnel, and the extension of the electric lines westward to Skykomish, Washington. The electrified mileage will thus be increased from 4 miles to 24 miles of main-line track, exclusive of sidings. This project constitutes what is reported to be the first step in a programme that will include 96 miles of main line *via* a new tunnel, from Gold Bar to Wenatchee.

Telegraph and Telephone Notes.

Communication with Aircraft.—TELEGRAPHY TO SUPERSEDE TELEPHONY.—In order to bring into effect the decision of the International Commission for Aerial Navigation that wireless-telegraphy instead of wireless-telephony shall be used for normal communication between air liners and aerodrome ground stations, which was embodied in regulations that came into force this year, flying mechanics of Imperial Airways, Ltd., are being trained as operators at the Marconi Co.'s College at Chelmsford. Hitherto wireless-telephony has been employed for the convenience of pilots who have themselves been able to speak direct to Croydon or other aerodromes. With the increasing volume of air traffic, however, it has been considered advisable to relieve the pilot of large passenger-carrying machines of this duty, and Morse-code telegraphy is to be gradually introduced in order to speed up traffic and avoid confusion. To provide for this change, the regulations lay down that all machines carrying 10 or more passengers must include a qualified wireless operator in the *personnel*, who will give his undivided attention to the wireless service. No change in the apparatus used on Imperial Airways machines will be involved, as the Marconi AD-6 aircraft set, which is their standard equipment, may be used either for telephony or telegraphy by the simple movement of a switch; telephony can still be used, of course, when desired.

India.—BURMA TELEGRAPH TROUBLES.—Complaints are made regarding the inefficient telegraph service between Burma and India, and when the Director-General of Posts and Telegraphs recently visited Rangoon, the Burma Chamber of Commerce represented to him that a submarine cable should be laid between Rangoon and India; however, the sea bed is singularly unfavourable to such an enterprise. A senior officer of the engineering branch has been instructed to inspect the lines between Burma and India, and Rs.1¼ lakhs have been sanctioned for the overhaul of these wires.

TELEPHONES IN BURMA.—The Posts and Telegraphs Department has, during the past two years, linked outlying places by public telephone circuits. In every case this has been done by making use of the existing telegraph wires, as the traffic would not be sufficient to justify the cost of erecting special telephone wires. The facilities thus provided have been much appreciated by the public, and Mandalay has in this way been linked with Maymio, Rangoon with Pegu, Thanatpin, Syriam, Kauktan and Tavoy with Harmingyi.

RANGOON'S FIRST WIRELESS TELEPHONE.—The Port Authorities in Rangoon have introduced a wireless telephone, the first one in Burma, between the Port Offices and the pilot vessel *Beacon*. The telephone is fitted with an automatic calling device, and the installation is capable of communicating with vessels at sea for a distance of 200 miles.

TELEPHONES IN CALCUTTA.—The report of the Calcutta Telephone Corporation for the year ended June 30th, 1926, draws

attention to the growth in traffic since the message rate system was introduced toward the end of 1924. The average cost of an exchange line has dropped from 23 rupees to 21 rupees 8 annas a month, and the number of lines has been increased by 100 a month. Ineffective calls have been reduced from 36 to 20 per cent. The profit for the year amounted to 570,000 rupees, says *Commerce Reports*. The number of exchange, extension, and private lines in Calcutta totals 11,549 for a population of 1,328,000.

Iceland.—TELEPHONE SERVICE.—Official figures show that the telephones in use now total 1,507,000, representing an increase last year of 145,000, the largest increase yet recorded, or 10.8 per cent. There is thus one telephone to every 29 persons, which leaves Britain still inferior to Iceland, with its one telephone to 26 persons. During the past year 170 new exchanges were opened.

Portugal. — SUBMARINE CABLE CONTRACT. — From Milan, Italy, we learn that a definite contract has lately been arranged between the Società "Italcable" and the Portuguese Government for the laying of new submarine telegraph cables between Lisbon, Malaga, Azores and Cape Verde. The Italian submarine cable system will, as a result, be notably increased by a new cable which, starting at Anzio, will cross the Tirreno and then continue across to Corsica and Sardinia, thence to Barcelona and on to Malaga.

Portugal.—INTERSTATE TELEPHONY.—The Portuguese Government is negotiating with the Spanish Government, says *The Times*, with the object of establishing telephone communication between Lisbon and Madrid.

Radio-Telegraphy.—"BEAM" STATION TESTS.—The short-wave "beam" stations recently completed by Marconi's Wireless Telegraph Co., under contract with the General Post Office, for wireless communication between this country and Australia, were taken over on January 14th by Post Office engineers for a week's official test. Preliminary tests indicated that the new Australian stations will provide a service as good as the Canadian, if not superior, says the *Daily Telegraph*. On the English side the transmitting station for the Australian service is situated at Tetney, a village six miles from Grimsby, and the receiving station is at Winthorpe, two miles from Skegness. Both the transmitting and receiving stations are connected by land wires with the Central Telegraph Office of the G.P.O. in London. In Australia the station for transmitting messages to England is near Ballan, fifty miles north-west of Melbourne, while the receiving station is at Rockbank, fifteen miles from Victoria's capital, with which both stations are connected by land wire to the chief telegraph office.

Submarine Telegraphy.—INCREASED OPERATING SPEED.—It is claimed that quicker communication between this country and South Africa is now possible, says the *Daily Mail*, as the result of two years' experiment by the engineers of the Eastern Telegraph Company. By abolishing the system of relaying messages from the islands of St. Vincent, Ascension, and St. Helena, and speeding up the rate at which the signals travel along the cables, it has become possible to receive messages in Capetown at the same instant as they are dispatched by the instruments in London. The new system of regenerator working, as it is called, will enable messages to be transmitted as fast as a person can talk, so it has been called "cable telephony." There will be no increase in charges.

The Telephone Service.—DEVELOPMENT IN LIVERPOOL.—Mr. W. J. Medlyn, superintending engineer, South Lancashire District, Post Office Engineering Department, has sent us a copy of the report of the Liverpool and District Advisory Committee for the year ended December 31st, 1926, which shows that progress has been made in all directions. The equipment at many exchanges has been increased, and complete new manual exchanges have been provided at Hoylake and Upton. A new exchange at Huyton will be ready for service early this year, and arrangements are also well in hand for providing new exchanges at Garston, Maghull, and Stockton Heath. Sites have been acquired for buildings at Prescot and St. Helens, in which exchanges of the automatic type will be installed. During the year 6,762 new telephones were fitted, a net increase of 4,125, or approximately 7½ per cent. The provision of additional underground cables is proceeding steadily, and several additional long-distance circuits to London and other important centres have been brought into use by means of the repeater stations associated with the main underground cable routes. There has been a further substantial increase in the number of calls dealt with in the district, the total approximating 62¼ millions (58 million local and 4¼ trunk), an increase of 6 per cent. over the previous year. Phonograms numbered 214,000, an increase of 10 per cent., and the new phonogram room at the Liverpool head Post Office has been equipped with the latest type of ancillary panel board. The use of street telephone call kiosks is still being extended. A new coin box, permitting of shillings, sixpences, and pence being inserted, has been introduced in certain towns and, if it proves successful, its issue will be generally extended.

FIRE ALARMS.—The question of extending and improving the system of public fire alarms is under consideration by the Liverpool Corporation.

TELEGRAPHS.—The type keyboards and automatic transmitters on the London and Paris routes have been entirely successful, and this method of working is likely to be extended to other routes. Direct telegraph working between Liverpool and Antwerp has been introduced, and the question of further direct lines between Liverpool and the Continent has been reviewed. The circumstances, however, are not such as to justify any extension in this direction at the moment, but the matter is being kept in view.

Transatlantic Radio-Telephony.—NEW RECEIVING STATION.—In connection with the recently-inaugurated transatlantic radio-telephone service, work is to start at once on the erection of a new receiving station in Fifeshire, on the estate of Sir Donald Makgill, Bart., of Kemback. Three lines of aerial masts will radiate from the station for a distance of three miles each, and in the event of the station proving satisfactory, substantial buildings will take the place of those now to be erected. A lead-encased cable will be laid between Kemback and Cupar Post Office. It is of interest to record the fact that one of the first calls across the ocean was made *via* a Relay automatic telephone installation in the *Daily Express* office in London.

MEXICO NEXT?—Telephone communication between Mexico City and New York is expected to be established this year over a direct wire some 3,000 miles long. It will then be a matter simply of linking up this new development with the transatlantic service. The Mexico City-New York service will be made possible by a "hook up" between the American Telephone and Telegraph Co.'s line from New York to Laredo (Texas) and the International Telegraph and Telephone Co.'s line, which is to be completed between Mexico City and Nuevo Laredo across the Rio Grande from Laredo. The total distance, as the crow flies, is about 2,676 miles, but some 400 miles are added by the telephone route.

Radio Notes.

Australia.—NEW STATION.—Arrangements are said to have been completed for the erection of a new broadcasting station in Melbourne, of the "B" class, on the top storey of a high building in the centre of the city; it will receive no revenue from licence fees, but will rely solely on advertising for its income. The call sign will probably be 3BO and the wave-length 255 metres, with a power of 500 watts. Provision is being made for suitable programmes of music and other special features, and one minute's advertising will be allowed between each item. The station will operate for four hours on each of six evenings a week, Mondays to Saturdays. At the present time Melbourne has two "A" class broadcasting stations (3LO and 3AR) and with the new station it will have two "B" class stations (3UZ and 3BO).

MANUFACTURE.—Good progress is being made with the local manufacture of wireless equipment. One of the largest manufacturers of radio parts is the Electricity Meter Manufacturing Co., Ltd., whose lines are marketed under the name of "Emmco." The latest addition to its plant is machinery for the manufacture of headphones, which are now being turned out in large numbers.

RESEARCH.—Details have been completed of important proposals for conducting organised research into problems connected with broadcasting in Australia. The Broadcasting Co. of Australia Pty., Ltd. (which operates 3LO) recently offered the University of Melbourne a grant of £500 a year for three years to enable the University to undertake wireless research work. The offer has been accepted, and it is understood that a similar offer has been made to the University of Sydney by Farmers Pty., Ltd. (2FC). The research work will be performed by the Faculty of Science under the direction of the Dean (Prof. T. H. Laby).—*Reuter's Trade Service* (Melbourne).

Canada.—WAVE-LENGTHS.—The wave-lengths of the broadcasting stations in some Canadian cities may be changed as a result of negotiations now in progress between Lieutenant-Commander C. P. Edwards, Director of Radio for the Dominion of Canada, and the Hon. Herbert Hoover, Secretary of Commerce in the United States, who has jurisdiction over the broadcasting stations in the Republic. According to *World Radio*, reception in Canada has been far from satisfactory of late owing to the clash of wave-lengths and to the fact that, following the decision of a Chicago court, certain United States stations are poaching on Canadian channels. It is hoped that the necessary legislation conferring full authority on Mr. Hoover may be introduced at Washington.

B.B.C. Advisory Committee.—LISTENERS' LIAISON.—The B.B.C. officially announces that, as the result of a conference of wireless organisations on January 13th, it has been decided to set up an advisory committee representative of four national societies, *viz.*, the Radio Society of Great Britain, the Radio Association, the Wireless Association of Great Britain, and the Wireless League. Capt. Ian Fraser, the blind M.P., who is prominently associated with the Wireless League and Radio Society, has accepted the chairmanship of the Committee, which will have as its main function the establishment of an effective liaison between the national societies of listeners and experimenters and the B.B.C. on matters of mutual interest.

Contract Information.

When "Contracts Open" are advertised in our "Official Notice" pages, the date of the ELECTRICAL REVIEW containing the advertisement is given in parentheses below.

Contracts Open.

Australia.—MELBOURNE.—February 28th. City Council. Two 2,500-kW motor-convertors and accessories, or two 2,500-kW rotary convertors, with transformers and accessories. (B.X. 3124.)*

March 14th. 6,600-V, 3-phase switchgear. (B.X. 3138.)*

March 8th. Postmaster-General's Department. Induction coils and registers. (B.X. 3136); testing instruments. (B.X. 3132.)*

March 7th. State Electricity Commission of Victoria. Paper-insulated lead-covered control cable. (B.X. 3137.)*

March 14th. D.c. switchgear and accessories. (B.X. 3131.)*

SYDNEY.—March 9th. New South Wales State Railways. Two sets of electric overhead travelling crane equipments. (A.X. 4103.)

Argentina.—BUENOS AIRES.—March 15th. Ministry of Marine. Machinery in connection with the extension of electrical generation (involving the enlargement of two existing power stations and the construction of two new ones) at the Naval Base, Puerto Belgrano. (B.X. 3140.)*

March 24th. Department of Navigation and Ports. Electric cranes, pumps, &c. (A.X. 4087.)*

Ayr.—January 27th. Education Committee. Electric lighting installation, school extensions, Prestwick. Mr. William Reid, Education Offices, Ayr.

Barnes.—February 8th. Electricity Department. One 1,000-kW rotary or motor convertor with transformer, l.p. switchgear and connections. (January 7th.)

Belfast.—February 5th. Electricity Department. One induction motor-driven vertical type centrifugal pump. (See this issue.)

Belgium.—IXELLES.—February 18th. Municipal Council. Armoured three-phase cable and armoured l.p. cable. Particulars for 9 fr. 30 c. from Bureaux du Service de l'Electricité, 20, Rue d'Alsace-Lorraine, Ixelles.

January 27th. Belgian Ministry of the Colonies, 7, Place Royale, Brussels. Seven tons of enamelled phosphor bronze wire in two lots, and 2,700 telephone line insulators. Particulars on application from Cahier des Charges. No. 116e.

Carlisle.—January 24th. Town Council. Electric lighting installation, blocks of 50 houses, Lower Sowerby estate. Mr. Percy Dalton, city engineer, 18, Fisher Street.

Clacton.—February 2nd. Electricity Department. Two 1,125-b.h.p. Diesel oil engines, direct coupled to 750-kW, 3-phase alternators; two 750-kW alternators, two rotary-convertors, and e.h.p. switchgear. (See this issue.)

Cheltenham.—January 31st. Corporation. Twelve months' supply of electric lighting fittings. Mr. J. S. Pickering, borough engineer.

Douglas.—February 28th. Corporation. 3¼ miles of e.h.p. cable, two synchronous motor alternators. (See this issue.)

Edinburgh.—January 25th. Edinburgh District Board of Control. Electric lighting installation at Bangour Mental Hospital. Mr. J. D. Gibson, surveyor, 60, Frederick Street, Edinburgh.

February 14th. Electricity Supply Department. E.h.p. and l.p. switchgear, e.h.p. and pilot cables. (See this issue.)

January 22nd. Gas Department. One electrically-driven automatically-controlled pump, complete, including all wiring. Mr. H. H. Gracie, engineer and manager, 15, Catton Hill, Edinburgh.

January 31st. Corporation. Structural steel work for extension of turbine house, Westbank, Portobello generating station. City architect.

Egypt.—EGYPTIAN STATE RAILWAYS.—Chief Inspection Engineer, Queen Anne's Chambers, S.W. Signalling materials and 43,420 metres of braided cable.—*Reuter's Trade Service* (Cairo).

Huddersfield.—January 28th. Huddersfield Industrial Society, Ltd., Butchering Department. Electricians' work required at premises, Hillhouse Lane. Messrs. Jos. Perry and Sons, architects, 3, Market Place.

India.—India Store Department. January 25th. Overhead electric travelling cranes. Specifications (5s.) from 15, Belvedere Road, Lambeth, S.E.

10 miles dry core telephone cable. (See this issue.)

Ilford.—February 1st. Electricity Department. 600-V, l.p. paper-insulated cables. (See this issue.)

Liverpool.—January 27th. Electricity Supply Department. Twelve months' supply of materials, including cables and accessories, meters, lamps, &c. (January 7th.)

London.—LONDON COUNTY COUNCIL.—January 31st. Electrical installation at the Hornsey Rise housing estate (approx. 1,100 wiring points). (See this issue.)

HAMMERSMITH.—February 16th. Electricity Department. Twelve months' supply of stores, including several electrical items. (See this issue.)

Macclesfield.—January 31st. Rural District Council. Electric generating plant to supply 24 houses at Gawsworth, consisting of engine, battery, switchboards, cable, small motor and pump; wiring for electric light installation, including lamps and meters. Mr. Geo. Clayton, architect, 4, Wellington Street, Stockport.

Manchester.—January 31st. Electricity Department. Two electrically-driven circulating-water pumps, piping, &c. (January 14th.)

February 4th. One 1,500-kW and one 750-kW motor convertors, with switchgear. (See this issue.)

Newport (Mon.).—February 5th. Electricity Department. Two water-tube boilers, steam and feed-water piping, economisers, air heaters, induced- and forced-draught plant, steel stack and grit catcher, coal and ash conveyors, extension of boiler house, including structural steelwork and foundations. (January 7th.)

New Zealand.—AUCKLAND.—March 22nd. Harbour Board. Electric motors, gearing, shafting, and control gear for the operation of vehicular and passenger gangways at the New Devonport Ferry Wharf. (A.X. 4102.)

Sleaford.—Electricity Works. 50 tons Diesel oil fuel. (January 14th.)

South Africa.—JOHANNESBURG.—February 10th. Municipal Council. Electric cable. (B.X. 3130.)*

Stoke-on-Trent.—February 9th. Electricity Department. Steam and water piping, valves, &c., constructional steel work, platforms, crane gantries, &c. (January 7th.)

Torquay.—Electricity Department. Two vertical circulating-water pumps for Newton Abbot power station. (See this issue.)

Dismantling and removal of four Babcock & Wilcox boilers from Newton Abbot power station. (See this issue.)

Uruguay.—MONTEVIDEO.—February 18th. State Electricity Works. 65,000 kg. unvarnished black iron wire and 10,000 kg. g.i. wire. (A.X. 4019.)*

February 11th. 37,500 electric filament lamps. (B.X. 3117.)*

February 15th. 55,500 iron pieces (angles, ties, bolts, &c.) for overhead lines. (A.X. 4018.)*

March 2nd. Lead fuse wire, silver fuse wire, switches, cable end boxes, compound and insulating type. (B.X. 3159.)

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Contracts Closed.

Barnes.—Urban Council. Accepted:—

Additions and alterations to switchgear (£1,626).—English Electric Co., Ltd.

Belgium.—Keen international competition was again in evidence last week when the municipal authorities of Schaerbeek opened tenders for the supply of 11½ kilometres of h. and l.p. electric cable. Offers were received from three Belgian, three German, one Dutch, one French, one Czecho-Slovakian, and two British concerns—the last being the British Insulated Cables, Ltd., and Callender's Cable and Construction Co., Ltd. The quotations ranged from £2,199 to £3,182, the lowest being that of the Société des Câbleries et Corderies du Hainaut, of Dour.

Croydon.—Tramways Department.

10 sets of tramcar electrical equipments.—General Electric Co., Ltd.

Dartford.—Urban Council. Accepted:—

Installing electric light at 188 houses (£5 7s. 6d. per house).—Mr. E. E. Beaven.

East Ham.—Town Council. Accepted:—

Bodies and top covers for 10 double-decked tramcars (£15,870); trucks and brakes (£2,460).—Brush Electrical Engineering Co., Ltd.

Motors, switches, &c. (£4,081).—British Thomson-Houston Co., Ltd.

London.—LONDON COUNTY COUNCIL.

Dry cells.—Edison Swan Electric Co., Ltd.

SHOREDITCH.—Lighting Committee. Accepted:—

House-service cable, 1 mile 19/.052, 1 mile 7/.064, 2 miles 7/.052 (£1,280).—W. T. Glover & Co., Ltd.

Electrical installation work at the City Corporation Dwellings, Shepherdess Walk, and the L.C.C. Dwellings, Horner House.

	City Corporation Dwellings.	Horner House, L.C.C.
Barlow Bros. & Co.	£1,463	1,130
Electrical Installations, Ltd. ...	1,485	1,124
Malcolm & Allan, Ltd. ...	1,697	1,253
H. J. Cash & Co., Ltd. ...	1,540	1,250
Toy & Winslow (accepted) ...	1,526	**1,042**
City Electrical Co. (accepted)	**1,400**	1,165

ST. PANCRAS.—Contracts and Stores Committee.

One 3,750-kVA transformer, complete with equipment for linking up with Islington (£1,901).—C. A. Parsons and Co., Ltd. (recommended).

Cable for linking up (£1,570).—Siemens Bros. & Co., Ltd. (recommended).

4-way 4-in. conduits (£600).—Doulton & Co., Ltd. (recommended).

Marlborough.—Town Council. Accepted:—

Installing electric lighting at 20 houses (£136).—James Bros.

Rochdale.—

Electrical equipment of the Townhead Mill Co.'s Duke Street mill, including motors, 20-200 h.p.—Swedish General Electric, Ltd.

Forthcoming Events.

British Electrical Development Association.—Friday, January 21st. Royal Society of Arts. 7.30 p.m. "Industrial Heating." Mr. S. E. Monkhouse.

Junior Institution of Engineers.—Friday, January 21st. 39, Victoria Street, S.W. 6 p.m. Exhibition of Scientific Instruments and Apparatus.

Friday, January 28th. 7.30 p.m. "The Design of h.p. Sub-stations." Mr. C. E. Atkinson.

Meter Engineers' Technical Association.—Friday, January 21st. Lighting Service Bureau. 7 p.m. "Testing of Large-Capacity Meters *in situ*." Mr. W. Casson.

Saturday, January 22nd. Engineers' Club, W. 5.30 for 6 p.m. First annual dinner.

Salford Technical and Engineering Association.—Saturday, January 22nd. Royal Technical College. 7 p.m. Presidential address by Mr. J. Morris, and musical social evening.

Association of Mining Electrical Engineers.—Saturday, January 22nd. Newcastle. "Static Transformers for Collieries." Mr. J. W. Rodger.

(Western Sub-Branch).—Saturday, January 22nd. Swansea. "The Working of Thin Seams with Electrical Power." Mr. D. P. Jones.

Nottingham Society of Engineers.—Monday, January 24th. "Lightning Conductors." Mr. G. A. Collier.

Institution of Electrical Engineers.—INFORMAL MEETING.—Monday, January 24th. London. "The Electricity Bill." Mr. M. Whitgift.

(Mersey and North Wales (Liverpool) Centre).—Monday, January 24th. Liverpool. "Electrical Equipment of Large Buildings." Messrs. J. Frith and F. Buckingham.

(North-Eastern Centre).—Monday, January 24th. Newcastle-on-Tyne. "60,000-V Underground Network of the Union d'Electricité," Col. E. Mercier; and "33,000-V Cables, with Special Reference to the S.L. Type." Mr. P. Dunsheath.

(North-Midland Centre).—Tuesday, January 25th. Leeds. Faraday Lecture, "What is Electricity?" Prof. W. M. Thornton.

(North-Western Centre).—Tuesday, January 25th. Engineers' Club, Manchester. "Recent Developments in Radio Reception." Mr. J. H. Reyner.

(Tees-Side Sub-Centre).—Thursday, January 27th. Middlesbrough. Annual dinner.

(London Students' Section).—Friday, January 21st. 6.15 p.m. "Electrons in Solid Conductors." Mr. S. N. Ray.

Institution of Production Engineers.—Wednesday, January 26th. 7.30 p.m. At the Society of Motor Manufacturers and Traders, Ltd., 83, Pall Mall, London, S.W.1. Discussion on "The Professional Registration of Engineers." Mr. R. Hazleton.

Electrical Power Engineers' Association (North-West Midland Section).—Wednesday, January 26th. Wolverhampton. 8 p.m. "Overhead Distribution." Mr. T. A. G. Margary.

Manchester Association of Engineers.—Thursday, January 27th. Manchester. "The Link Between Theory and Practice in Engineering." (Open discussion.)

Birmingham Electric Club.—Friday, January 28th. Grand Hotel. 7 p.m. Presidential address.

Institution of Engineering Inspection.—Friday, January 28th. Royal Society of Arts. 7.30 p.m. "Manufacture and Uses of Arsenical Copper." Mr. J. Taverner.

The "Electrical Review" Service Department.

INQUIRIES must be accompanied by a stamped addressed envelope.

We should be glad to learn the names and addresses of makers of the following:—

JASEN vacuum cleaners.

Notes.

Electric Vehicle Records.

We have received a copy of a mechanical road transport cost sheet, which has been prepared by the Electric Vehicle (Main) Committee of Great Britain. Each sheet forms a record for one vehicle for one month, and notes on the use of the sheet are printed on its back. Copies are obtainable from 15, Savoy Street, Strand, London, W.C.2.

Birmingham Electric Club.

The programme of this Club for the first half of 1927 includes the following fixtures:—January 28th, presidential address; February 25th, "Wireless Telephony," by Mr. C. G. A. McDonald; March 11th, annual dinner; March 25th, "Electricity Supply in the Midland Area," by Mr. S. T. Allen; April 22nd, "Radiation Effects," by Mr. J. B. Kramer.

"Wireless" Moving Pictures.

The broadcasting by "wireless" of moving pictures was demonstrated by Dr. E. F. W. Alexanderson in New York on January 10th, says *The Times*. With simple apparatus he projected upon a screen by wireless a moving picture of himself conversing with a friend. The reproduction was crude, but the heads and arms of the two figures moved as they had done in the original. In addition, the inventor exhibited three photographs which had been broadcast with his apparatus for a distance of two miles. They looked as though they had been painted with a brush, but were clear reproductions, one, the portrait of a woman, having much of the quality of an original photograph. The method employed by Dr. Alexanderson is, as he frankly said, similar to a process already used commercially, but the new process, though under the disadvantage of being more affected by atmospherics than the dot and dash system now used, has the advantage of speed. Even now it takes Dr. Alexanderson only two minutes to broadcast a picture, and when the apparatus is perfected television may be expected as an early development. To make a picture, the inventor directs upon a screen seven beams of light, multiplied 24 times by mirrors. The beams are rotated rapidly and travel from top to bottom and from right to left of the screen, illuminating its entire surface with lines of light of varying intensity. The modification of these lines by means of a reflected image, which modulates their tone values, produces the picture.

I.E.E., Western Centre, Dinner.

On January 10th, the annual dinner of the Western Centre of the Institution of Electrical Engineers was held at the Royal Hotel, Bristol. Mr. W. G. Heath, chairman of the Centre, presided, and about 130 members and guests were present. The occasion was marked by a presentation to Mr. A. J. Ostler, the retiring joint honorary secretary of the Centre, who received a slide rule, and a silver tray for Mrs. Ostler, in recognition of his valuable services to the Centre. In calling upon Dr. W. H. Eccles, president of the Institution, to make the presentation, Mr. Heath described Mr. Ostler as a large man with a still larger heart. Mr. C. T. Allan, hon.

secretary, spoke of the great help he had had from Mr. Ostler during their years of joint secretaryship.

After the loyal toasts, the Rt. Hon. the Lord Mayor of Bristol, Alderman E. M. Dyer, proposed "The Institution of Electrical Engineers." He referred to the rapid strides made of recent years in the electrical world and to the part played by England. His only complaint with regard to his local undertaking was that the product might be cheaper.

Dr. Eccles, in reply, said that the Institution constituted an electrical parliament. It represented all phases of electricity from the "nippy" little electrons to large-power turbines. This year would prove the most important year in the life of the Institution up to the present. It was marked by transatlantic telephone development, the passing of the Electricity (Supply) Act, and the introduction of new communication cables with "Permalloy" loading giving a tenfold speed increase. Now that the Electricity (Supply) Act was established he believed and hoped that controversy on the subject would be dropped and that all good citizens would help to make it a success. It would result in a much fuller use of electricity. He had recently returned from Northern Italy, where power lines were more numerous than telephone lines. He thought that as a result of the electrification of Northern Italy the people were more prosperous now than before the war. Our men were earning less in purchasing power than those in that country. This year ought to see us lead the procession in the world's electrical advancement.

Mr. C. G. Morley New proposed "Our Guests," to which the Sheriff of Bristol, Mr. Frank E. Sampson, and Mr. J. H. Inskip, chairman, Bristol Electricity Committee, replied. The Sheriff believed that largely as a result of the work of electrical engineers this country would again lead the world in industry. He was a mechanical engineer, but it was plain to him that the electrical profession was the leading one. He was impressed by the spirit of co-operation in the ranks of the Institution. Mr. Inskip referred to Bristol's new scheme and hoped that they would soon have the opportunity of showing the members of the Institution one of the largest and most up-to-date generating stations in the country. He paid a tribute to Mr. Faraday Proctor, city electrical engineer, Bristol, Mr. A. J. Newman, the deputy engineer, and Mr. Ostler, for the work they had done on the undertaking.

Mr. W. J. Bache, Cheltenham, proposed "Kindred Institutions" and referred to the cordial relations which existed between the Western Centre and other Institutions, in particular, the South Wales Institute of Engineers and the Institution of Post Office Electrical Engineers.

In reply, Mr. E. J. Eldridge, Institution of Post Office Engineers, referred to the close association which had always existed between the P.O. Institution and the I.E.E.

Mr. Thomas Hood made an appeal on behalf of the Institution benevolent fund. The estimated income for the present year was £1,700, which, for a membership of nearly 13,000, was unsatisfactory. During the evening musical items were given by the Bristol Glee Singers.

The proceedings were concluded by a vote of thanks to the chairman, proposed by Dr. Eccles, to which Mr. Heath very briefly replied.

Appointments Vacant.

Meter mechanic and tester for the Rawtenstall Corporation Electric Tramways and Motor Department. Mains assistant engineer for the Crewe Corporation Electricity Department. Cable jointer for the Corporation of Nelson Electricity Department. Meter mechanic for the Wimbledon Corporation Electricity Department. Assistant mains engineer (£271), for the City of Chester electricity department; draughtsman for the Stepney Corporation electricity department. (See our advertisement pages to-day.)

A Lecture to Contractors.

Mr. Alexander Ramsay, consulting engineer, Glasgow, read a paper before a meeting of the SCOTTISH ELECTRICAL CONTRACTORS' ASSOCIATION in Glasgow, on Tuesday last week, on questions relating to the industry, dealing especially with some aspects of the Electricity (Supply) Act.

Mr. Ramsay said it seemed probable that many undertakings would continue to retail electrical energy under the existing conditions, particularly where the supply was direct current, such stations purchasing a.c. energy from the Central Electricity Board to operate rotary converters or other transforming plant. Unless every undertaking retailed standardised alternating current, the argument in respect of mass production and consequent reduced cost of manufactured electrical goods completely broke down, even with regard to the home market.

It was claimed, and the general public had been led to believe, that under the Bill the cost of electrical energy would be materially reduced. There appeared to be little justification for optimism in this direction, however, since the conditions under which, it would appear, the business of generating, distributing, and retailing electricity was to be conducted suggested an increase rather than a decrease in the rate per unit. Whilst the annual cost of electrical energy, even in the case of the large consumer, was trivial in relation to the total oncost charges, rarely exceeding 2 or 3 per cent., it must be borne in mind that owing to the keenness of competition, manufacturers found themselves obliged to curtail their oncost charges in every direction. To assume that electricity would be left a free field for development would be absurd, and, it might be accepted, that the war between electricity, gas, and oil would be waged more fiercely in the future than in the past. Consequently, unless supply authorities continued to offer electrical energy on such terms that it could compete successfully with other forms of power, it was probable that the tendency would be, particularly with the larger consumers, towards installing private plant. Indications were not wanting that a period of industrial activity was about to be experienced, and, instead of allowing our industrialists freedom to make good, now that the opportunity has arrived, it seemed to have been decreed that many of them should be harassed with electrical re-equipment. Was that sound business?

Dr. Eccles, when speaking at the recent dinner of the Glasgow Branch of the I.E.E., was reported to have stated that "in consequence of the Electricity Bill having become law, the services of many additional professional engineers would be required"; that might be, but it would appear that the chief beneficiaries were likely to be gentlemen attached to the legal profession.

That the Bill was viewed with grave misgiving by certain sections of the industry was common knowledge; but, the Bill being an accomplished fact, it was for all concerned to make the best of it.

Mr. Ramsay then dealt with other questions, and said with regard to contract documents in Scotland, the conditions, in terms of which work should be executed, were, as a rule, framed in conformity with the Scottish National Building Code, the interests of client and contractor alike being fairly well protected. But with regard to electrical work, revision might be desirable since, in certain districts, the tendency was to invite tenders on the lump-sum basis—a most pernicious practice, and one which was equally unjust to the parties principally concerned. In support of the lump-sum tender the claim was made that the plans should be so prepared, and the quantities measured therefrom should be so scrupulously accurate as to render after-measurement unnecessary. Such Utopian conditions were seldom encountered in practice, however. In the course of installation unforeseen obstructions invariably presented themselves, or the client, to suit his needs, decided to alter the plans. Under such circumstances a contract let on the basis of after-measurement could be readily adjusted, whereas, more often than not, the lump-sum tender was the subject of litigation. On a properly drafted specification and schedule the variation between the lowest and the highest offers should not exceed 10 to 15 per cent., and more frequently than not it was well within the lower limit.

Extra-high-pressure Steam Plant at Bradford.

As briefly mentioned in a leaderette last week, Mr. Thos. Roles, M.I.E.E., city electrical engineer, has put in hand for the Corporation electricity works at Valley Road an installation of unusual design, consisting of a boiler to work at 1,100-lb. gauge pressure and a 2,500-kW turbine which will exhaust into the existing main steam range at 195-lb. gauge pressure, the turbine acting as a reducing valve. The steam will be superheated to 800 deg. F., and will not require reheating; the boiler will have a rated output of between 75,000 and 94,000 lb. per hour. The size of the plant has been so chosen that the electrical output of the new set, together with that of the low-pressure plant using the exhaust steam from the former, will be as nearly as possible equal to the estimated future base load of the station, which will thus be dealt with on the most efficient lines. No condensing plant being required, the water supply to the station need not be augmented. Provision has been made for reheating the steam exhausted from the new set, if thought advisable in the future.

The boiler will be equipped with divided chain-grate stoker gear and compartmental balanced draught. A combination of air preheater and economiser has been adopted, and the furnace is to be provided with water screens and air-cooled side walls. The turbine will be a plain impulse machine running at high speed and driving the alternator through gears at 1,000 r.p.m. The feed pumps, valve gear, instruments, and control will be of special design.

The whole contract has been placed with the English Electric Co., Ltd., which, it is generally known, has for many years been quietly conducting experiments on the use of h.p. steam. The Benson boiler plant of the company, which generates steam at the critical pressure, has put the company in a position to test out many of the pressure and temperature problems met with in plant such as that referred to. During the last eight years a number of finished turbines for working at a pressure of 1,500 lb. have been tested out at the Rugby works of the English Electric Co. The h.p. boiler plant is to be supplied, through the English Electric Co., by Messrs. Babcock & Wilcox, Ltd. It is interesting to learn that, prior to placing the order for the new plant, Mr. Roles made an extended visit in the United States to all the power stations and engineers in that country where experience of the higher pressures had been obtained. While it was decided that at the present time the adoption of pulverised-fuel equipment would probably not be justified, provision has been made in the combustion chamber of the new plant for the adoption of the new system of firing should it be found to be economical. The estimated cost of the new plant and boiler house is £80,000, but we learn that the Electricity Commissioners have approved of a scheme which includes the provision of a new 20,000-kW turbo-generator the total cost of the scheme will be about £300,000.

E.A.W. Activities.

The first fixture of the Electrical Association for Women for 1927 was a visit to Messrs. Liberty's "All-Electric Canteen" on January 19th. Mrs. I. E. Bray, a member of the E.A.W. Council, lectured before the Women's Institute and Women's Citizens' Association at Wendover, Stoke-Mandeville, and Haddenham on January 10th and 12th. Mr. Turnbull, the Aylesbury engineer, provided electrical apparatus for demonstration purposes. The E.A.W. also took part in the recent Electrical Exhibition at Ashford, Kent, when Mrs. I. E. Bray lectured. A branch of the Association is about to be formed on the North-East Coast, with headquarters at Newcastle-on-Tyne. Miss Anna Holm is acting as hon. secretary, and the inaugural meeting will probably be held early in February.

Institution Notes.

Institution of Electrical Engineers.

SCOTTISH CENTRE.—Mr. R. Borlase Matthews, M.I.E.E., lectured in Edinburgh, on January 11th, under the auspices of the Scottish Centre of the Institution, on the subject of "Electro-Farming." There was a large attendance of electrical engineers, while the farming industry was well represented; Mr. W. L. Winning, M.I.E.E., chairman of the Centre, presided. Mr. Matthews did not say that electricity was going to be the one salvation of the farmer, but the modern farmer, he contended, would not be able to "get on" without an adequate supply of cheap power such as electricity would provide. It was of vital importance to the whole nation that agriculture should be placed on a sound basis, and on this account alone the subject was well worthy of the most serious investigation by the electrical engineering world. The instinctive nature of the lecture was increased by the films and slides shown, illustrating many of the uses to which electric power is now being put on the lecturer's own farm at East Grinstead, Sussex and on farms abroad. An interesting discussion was taken part in by many well-known Scottish agriculturists.

Mr. Matthews also lectured to the members of the Institution, Dundee, last week. Mr. J. S. Thomson, of the Fife Power Co., presided. The lecturer said he had toured Fife that day and had found that something like 65 farms were using electric power. He was sure the methods adopted in Fife were more advanced than any he had seen.

INFORMAL MEETING.—At the meeting on Monday, January 10th, Mr. F. Pooley was in the chair, when Mr. O. M. Andrews opened a discussion on a paper by Mr. L. Henshaw, entitled "Some Notes on the Earthing of Metal Objects other than Conductors." The discussion, in which 16 members took part, showed how very difficult it might sometimes be to obtain an efficient "earth." In London and many big cities the water system might form a perfect earth, but in dry districts the difficulties were often almost insuperable. It was in the cities, however, where the extended use of domestic apparatus made efficient earthing imperative, that the occasion when, sooner or later, the "earth" would be called upon to function had to be provided for.

Faraday Society.

A general discussion on "The Theory of Strong Electrolytes" will be held at Oxford on Friday, April 22nd, and Saturday, April 23rd. On the first day "Ionic Mobility" will be the subject of debate, and on the second day "The Activity of Strong Electrolytes." Arrangements are being made to accommodate members attending the meeting at Exeter and Lincoln Colleges, but the accommodation is strictly limited, so that early application should be made. An inclusive charge of £1 2s. per head will be made to members. The charge to non-members will be 30s. Arrangements are being made with the railway companies for tickets at reduced rates. The second (experimental) "Report on Atmospheric Corrosion," by Dr. W. H. J. Vernon, will be read and discussed before the Society in London on Wednesday, March 30th, at 3 p.m.

Junior Institution of Engineers.

On Friday, January 14th, Mr. R. L. Kirlew (Chairman of the Institution) read a paper entitled "The Thermionic Valve and its Characteristics." One of the points made by Mr. Kirlew was that it was always advisable to ascertain the plate current-grid volts characteristic of a valve with a loaded anode circuit when signals were being received, as there was a difference between the graphs obtained with a loaded and an unloaded valve. The curves issued by valve manufacturers with their goods were obtained with an unloaded valve. The method recommended really gave a characteristic curve of the complete receiving circuit, and so enabled the most suitable working conditions to be observed. Some little trouble was necessary to obtain the data in order to make the various adjustments, but the advantages to be gained were of value, especially in sets designed and constructed by amateurs. For very accurate work in a multi-valve set, a measuring instrument in each circuit was desirable, but quite a lot might be done with one combined instrument, of which there were several known types.

Our Personal Column.

(Electrical men are invited to enable us to keep readers of the "Electrical Review" posted concerning their movements.)

Mr. CHARLES VERNIER, who, as mentioned in our last issue, is leaving the Newcastle-on-Tyne Electric Supply Co. to become chief engineer to the Macintosh Cable Co., Ltd., on February 1st, was educated at the Regent Street Polytechnic and at the City and Guilds of London Technical College, Finsbury. He served his apprenticeship with Messrs. Reyrolle and Co., and after experience with other firms he was appointed in 1897 to be electrician in charge of testing work with the Brockie Pell Arc Lamp Co. Two years later he became assistant engineer on mains work with the Cork Electric Tramways and Lighting Co. He entered the service of the Newcastle-upon-Tyne Company as mains engineer in 1900 and has remained there until now. For 21 years he was in charge of the mains construction, repair and maintenance work for that company, and its associated concerns, from their absorption. When he joined the company it had only five miles of cable route in existence and he has been responsible for the laying down of the major part of the large transmission systems (overhead and underground) and of numerous distributing networks operated by the Newcastle companies over an area of 1,800 square miles. For the past five years he has been their technical expert on mains construction work. Amongst the most notable work for which Mr. Vernier was responsible we

Elliott & Fry [*London.*

Mr. Charles Vernier, M.I.E.E.

may mention the laying down in County Durham of the first large 20,000-volt cable system in the world, comprising initially 40 miles of 3-core cable in 1906 and continuous current extensions in subsequent years; also the laying down of the first 66,000-volt cables and 66,000-volt overhead transmission lines in Great Britain, from 1923 to date. Mr. Vernier was chairman of the North Eastern Local Section of the I.E.E. in 1913 and a member of Council from 1920 to 1923. He is a member of the Overhead Lines Regulations Committee, and his papers read before the Institution include one on "The Laying and Maintenance of Transmission Cables" and one on "Wayleaves." He has performed numerous important activities in the electrical industry, such as his connection with the E.P.E.A., the Joint Industrial Council of the Electricity Supply Industry, and committee work under the British Electrical and Allied Industries Research Association, and he is, of course, well known as the inventor of various improvements in electrical cables and joints.

The Burton-upon-Trent Corporation has increased the salary of Mr. A. B. SLATER, the general manager of the tramway and motor system, by £75 per annum.

Mr. JOHN A. CRESSEY, control electrical engineer to the South Wales Electrical Power Distribution Co. at the Upper Boat Station, Cardiff, has been appointed engineer-in-charge of the power station of the Shanghai Municipal Electricity Department. He will sail on January 28th.

Mr. H. M. PEASE, managing director of Standard Telephones and Cables, Ltd. (formerly Western Electric Co., Ltd.), of Connaught House, Aldwych, W.C.2, has been appointed vice-president of the International Standard Electric Corporation. It was in 1902 that Mr. Pease (whose photograph accompanies these notes) first became associated with the Western Electric Co., Ltd.; being in charge of the engineering side of the business, he was responsible for the installation of the majority of the central-battery telephone exchanges erected in this country for the National Telephone Company and later the General Post Office. In 1908 he became sales manager of the Western Company and in 1919 managing director, which position he now holds. Mr. Pease included amongst his other activities a directorship in the recently dissolved British Broadcasting Company.

Elliott & Fry] [*London.*

Mr. H. M. Pease.

M. JEAN-BAPTISTE PERRIN, Professor at the Sorbonne, Paris, has been awarded the Nobel prize for physics.

M. BARTHELMY, who has lately been elected president of the Radio Club de France, is well-known in French electrical circles. After serving in the army for the first two years of the war he was appointed director of the French military wireless factory. Since then he has been associated as consulting engineer with several French manufacturers and in 1921 gave successful demonstrations of radio-telephony on moving trains.

Dumfries Town Council has appointed Mr. J. D. MARSHALL as Corporation electrician for the ensuing year.

With reference to the statement appearing on p. 1085 of our issue of December 31st regarding the appointment of Mr R. W. WILLIS as consulting engineer to the Corporation of Newark-on-Trent, Mr. Willis informs us that though the matter has been considered by the Corporation he has received no official intimation with regard thereto and in consequence he has made no decision.

Mr. G. E. WHITTLE has been appointed mains engineer to the Calcutta Electric Supply Corporation, Ltd., and he leaves for Calcutta on January 22nd.

In response to an invitation by the Ministry of Transport, the Emergency Committee of the Convention of Royal Burghs, Scotland, recommends Treasurer GRAHAM GUEST, Edinburgh, for appointment to the Central Electricity Board under the Electricity (Supply) Act, 1926. Mr. Guest is a member of the Institute of Treasurers, and managing director of Messrs. MacVitties, Guest, Ltd. He has taken a keen interest in electrical development.

We learn that Mr. J. W. THOMAS, B.Sc., assistant general secretary of the Electrical Power Engineers' Association, is one of the successful candidates in the Bar final examinations. Mr. Thomas expects to be called to the Bar of the Middle Temple in June next.

Obituary.—MR. J. W. CUSHNY.—From an announcement published in *The Times* we note that Mr. John William Cushny, electrical engineer for the construction of the Kojuk Pass Tunnel, India, 1888-89, "subsequently lighting Pretoria and Johannesburg, latterly resident owner of a ranch at Lumbwa, British East Africa," passed away on December 30th at Warner Beach, Natal, "after long suffering." He was 64 years of age.

MR. S. M. BANKER.—We regret to read in *The Times* that the death occurred on January 16th of Mr. Stewart Melville Banker, late Superintendent Electrical Engineer to the General Post Office, at the age of 82 years. The interment took place yesterday at the Great Northern Cemetery, New Southgate.

DR. E. HEILBRON.—The death is reported from Berlin, at the age of 65 years, of Dr. Ernst Heilbron. The deceased was one of the leading experts in Germany on electricity meters, and he had been associated with the A.E.G. for upwards of 35 years.

Will.—The late Sir J. W. SZLUMPER left £1,309 gross and £439 net personalty.

Financial Section.

New Companies, Returns of Share Capital, Debenture Changes, Reports of Electrical Companies, Dividend Results, Transactions in Stocks and Shares.

New Companies Registered.

Boynton & Co., Ltd.—Private company. Registered January 13th. Capital, £300 in £1 shares. Objects: To carry on the business of manufacturers, importers and exporters of and dealers in wireless apparatus, electrical goods, motor cars, &c. The first directors are:—H. Boynton, 4, Woodstock Road, Moseley, Birmingham; Ernest Boynton, 24, Valentine Road, King's Heath, Birmingham; Evelyne Boynton, 4, Woodstock Road (as above). Qualification, 1 share. Registered office: 34, Bradford Street, Birmingham.

Lamb & Co. (Westcliff), Ltd.—Private company. Registered January 12th. Capital, £100 in £1 shares. Objects: To acquire the business of Lamb & Co., Ronald Park Avenue, Westcliff-on-Sea, carrying on business as electrical engineers and contractors, makers of armatures, field coils, stators, &c. The first directors are:—A. A. Lamb, 30, Electric Avenue, Westcliff, electrical engineer; C. C. Mee (same address), electrical engineer. Qualification, 1 share.

Natural Power, Ltd.—Private company. Registered January 10th. Capital, £1,500 in 1,250 ordinary of £1 and 5,000 founders of 1s. each. Object: To adopt an agreement with H. Rowsell for the purchase of a scheme in regard to the production of light, heat and power from natural sources, of which he is the originator or inventor, and to carry on the business of electricians, mechanical engineers, dealers in electricity, &c. The first directors are:—H. E. Nickels, F.C.S., 125, Hendcorn Road, Thornton Heath, analyst; H. Rowsell, 41, Trafford Road, Thornton Heath, accountant. Solicitors: Jordan & Lavington, 78, Queen Victoria Street, E.C.4.

Wireless Pictures, Ltd.—Private company. Registered January 13th. Capital, £100 in £1 shares. Objects: To acquire any patents for inventions relating to television and what is known as "photo-telegraphy," and for the electrical transmission and reception by wire or wireless of signals, drawings, photographs and the like, &c. The subscribers (each with one share) are:—J. M. Sharp, 75-7, Shaftesbury Avenue, W.1, solicitor; F. R. Sprinz, 75-7, Shaftesbury Avenue, W.1, solicitor. Qualification, 5 shares. Solicitor: J. M. Sharp.

Johnson, Ross & Co., Ltd.—Private company. Registered January 14th. Capital, £100 in four 7 per cent. cumulative preference and 96 ordinary shares of £1 each. Objects:

To acquire the business of a vendor of electric lamps and wireless valves carried on by W. H. Johnson, at Kingsway Corner Buildings, 109, Kingsway, W.C.1. The directors are:—W. H. Johnson, Coppermill Road, Horton, nr. Slough, Bucks.; C. B. Liddell, 25, Cleveland Square, W.2; N. O. Liddell, The Croft, Chiltern Road, Chesham Bois, Bucks. Qualification: £1. Secretary: N. O. Liddell. Registered office: Kingsway Corner Buildings, 109, Kingsway, W.C.1.

Ernest Jones & Co., Ltd.—Private company. Registered January 13th. Capital, £500 in £1 shares. Objects: To acquire, as from December 1st, 1926, the business of electric light, power and radio engineers carried on by Ernest Jones and Co., at 1, Cateaton Street, Manchester. The first directors are:—E. Jones, 540, Hepshaw Lane, Stockport, electrical and radio engineer (permanent governing director); Mrs. H. Jones, 540, Hempshaw Lane, Stockport. Qualification, £10 shares. Secretary, E. Jones. Solicitors: Pearson, Son & Co., 438, Corn Exchange Buildings, Manchester.

Official Returns of Electrical Companies.

Robert W. Blackwell & Co., Ltd.—Particulars filed of £14,000 debentures authorised December 29, 1926, charged on the company's undertaking and property, present and future, including uncalled capital, the whole amount being now issued.

Woodstock Power Syndicate, Ltd.—Particulars filed on December 29th, of £2,300 debentures authorised October 4th, 1926, charged on the company's undertaking and property, present and future, the whole amount being now issued.

H. L. Wood & Son, Ltd.—W. E. Beales, of 1, Worcester Street, Belgravia, S.W., ceased to act as receiver on January 6th, 1927.

Barnes Brothers (Radiex), Ltd.—Debenture dated December 14th, 1926, to secure £1,000, charged on the company's undertaking and property, present and future, including uncalled capital (if any). Holder: P. G. Barnes, 109, York Road, Southend.

Wye Lighting, Heating and Power Co., Ltd.—Charge on premises at Wye, Kent, dated January 3rd, 1927, to secure all moneys due or to become due from the company to Lloyds Bank, Ltd., not exceeding £600.

Teignmouth Electric Lighting Co., Ltd.—Satisfaction to the extent of £500 on August 19th, 1924, of debentures dated February 19th, 1923, securing £4,000. (Notice filed January 8th, 1927.)

Electrical Devices, Ltd.—Debenture dated January 5th, 1927, to secure £1,250, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: Branch Nominees, Ltd., 15, Bishopsgate, E.C.

Oriental Telephone and Electric Co., Ltd.—Satisfaction to the extent of £2,316 on December 20th, 1926, of debenture stock secured by trust deed dated June 28th, 1905, and supplemental deed of acknowledgement dated June 12th, 1907, securing £200,000.

Win-Sum Electric Diffusers, Ltd.—G. A. Siday, Plant House, Ealing, W.5, ceased to act as receiver or manager on July 9th, 1926. (Notice filed January 11th, 1927.)

Patent Conveyor Co., Ltd.—J. R. Watson, Cheapside, Bradford, was appointed receiver on January 7th, 1927, under powers contained in instrument dated March 5th, 1908.

City Notes.

Marconi Interests in Argentina.

The November *Journal* of the British Chamber of Commerce in the Argentine Republic reports that an arbitration tribunal, consisting of Mr. A. G. Pruden, C.B.E., Major W. A. McCallum, and Mr. R. Fraser, of the Council of the Chamber, has issued its findings in a dispute between Marconi's Wireless Telegraph Co., Ltd., and the Cia. Marconi de Telegrafia sin Hilos del Rio de la Plata. The matter had been before the Argentine Courts for some years without result. The Argentine company brought an action against the British company for breach of contract, but finally the British company offered to purchase the undertaking of the Argentine concern outright. This was agreed to, and the tribunal was appointed to determine the purchase price and conditions. The total price has been fixed at $3,236,928 (Argentine gold), and this includes the cost of damages sustained by the Argentine company as a result of the British company's non-fulfilment of its obligations. The tribunal also stipulates the manner in which the money shall be apportioned to the shareholders of the Argentine company.

Companies to be Struck off the Register.

The names of the undermentioned companies will be struck off the Register at the expiration of three months unless cause is shown to the contrary:—

Blackpool and Garstang Electric Light Rly. Co., Ltd.
Bovey Light and Power Co., Ltd.
Clar-o-phon Radio Co., Ltd.
Electric Lamp and Bulb Co., Ltd.
High Temperature Generators (1918), Ltd.
Horsa Electrical Contracting Co., Ltd.
Ivor Electrical Co., Ltd.
Mayfair Light and Power Co., Ltd.
National Conduit and Cable Co,. Ltd.
Pneumatic and Electric Syndicate, Ltd.
Sceando Lamp Co., Ltd.
Searlight Projectors, Ltd.
Southport Electrical Supply Co., Ltd.

Stock Exchange Notices.

Dealings in the following have been specially allowed by the Committee under Rule 159:—

Compania de Electricidad de la Provincia de Buenos Aires—350,000 new 8 per cent. non-cumulative participating preference shares of £1 each, issued at par, partly paid and fully paid, Nos. 175,001 to 525,000.

Hankow Light and Power—4,000 8 per cent. cumulative second preference shares of £5 each, fully paid, Nos. 1 to 4,000.

The undermentioned have been ordered to be officially quoted:—

Coventry Chain Co., Ltd.—100,000 ordinary shares of £1 each, fully paid, Nos. 400,001 to 500,000.

Hendon Electric Supply Co., Ltd.—146,450 6 per cent. cumulaive preference shares of £1 each, fully paid, within Nos. 1 to 150,000.

London Power Co., Ltd.—£4,000,000 5 per cent. debenture stock.

New Chinese Companies.

The *Chinese Economic Bulletin* states that during the past few months the following electricity supply companies have been formed:—The Fuyang Ping Li Electricity Supply Co. (Szepo, Western Chekiang); the Sing Hing Electric Light Co. (Yuankiahsiang); the Shentang Electric Light Co. (Shentangchen); the Pu Yao Electric Light Co. (Yotsing, Eastern Chekiang); the Tsungjen Electric Light Co. (Chenghsien); the Chowhong Electric Light Co. (Yuyao), and others at Fotang and Santunchen (Hangkow).

Anglo-American Telegraph Co., Ltd.

The directors announce balance dividends of 1¼ per cent. on the ordinary consolidated and preferred stocks and a first and final dividend of 1¼ per cent. on the deferred stock. The total ordinary dividend is 3¾ per cent. and the total preferred dividend 6 per cent., as in the previous year.

Electrolytic Zinc Co. of Australasia, Ltd.

A dividend of 6 per cent. has been declared on the preference and ordinary shares for the six months ended December 31st, as in the preceding year.

Italian Loan in New York.

It is reported that the $10,000,000 loan floated in New York on behalf of the Unione Esercizi Elettrici met with immediate success.

Traction and Power Securities Co., Ltd.

The directors recommend a final dividend of 10 per cent. on the ordinary stock, making 14 per cent. for the year, as compared with 13 per cent. for the previous year.

Brazilian Traction, Light and Power Co., Ltd.

A quarterly dividend of 1¼ per cent. has been declared on the common stock, as against 1¼ per cent. last year.

Stocks and Shares.

MONDAY EVENING.

ACTIVITY and rising prices continue to characterise most of the Stock Exchange markets. The epidemic of influenza forms no check to the healthy expansion of general business. A boomlet in gilt-edged stocks is an excellent tonic to other securities. The reason is that, as investment finds the supply of the best-class stocks is diminishing, the would-be buyer enlarges the scope of his search, and takes what he can obtain in other issues. The market in the new 4 per cent. Consolidated stock is due to start on the Thursday in this week, and the recent advances in gilt-edged descriptions are deemed to hold the promise of a possible premium on the 4 per cent. scrip. London Power 5 per cent. debenture, at 98, stands at 3 premium over its issue price. Traction and Power Securities 4½ per cent. debenture stock has strengthened

to 87, at which price it returns £5 3s. 6d. per cent. on the money. The stock is redeemable at 100 in 1974. Recently-introduced, City of London Electric 5 per cent. debenture, January and July interest, is on offer at 99 ex dividend, the yield being £5 1s. per cent. on the money.

Shares in the London electricity supply group are steady in price, and there is still divergence of opinion as to the correct method to employ in calculating the yield derivable from investment in the ordinary shares at current prices. As previously explained, we take the austere, perhaps too austere, dividend rate of 7 per cent. that will become common to all the companies' ordinary capital after 1931. The Charing Cross date is after 1936. If the 1927-31 dividends, inclusive, are taken alone, the returns will be, of course, higher, and Westminsters, for example, show a little over 7 per cent., South Londons 7 per cent., Londons £6 19s. per cent. on the money for the next five-year period. Optimism, moreover, maintains it to be quite conceivable that some of the companies, after 1931, will be able to make such price concessions as will enable them to increase the statutory 7 per cent. dividend fixed by the Electricity Acts on the basis of existing charges to consumers. In this expectation resides the hopefulness of there being a possible rise in the share prices, a rise which otherwise could hardly be looked for in face of a known reduction to 7 per cent. dividends all round.

A jump of 3s. in Marconis to 16s. 9d. is an outstanding feature in their section. The precise reason has not yet been made apparent, but the accepted explanation in the market is that the company is regarded as likely to benefit by the long-distance telephony which is the latest marvel of wireless development. Probably there were a good many bears about, and they, rendered timid by the strength of markets as a whole, have turned buyers. Canadian Marconis are, sympathetically, the turn stronger at 3s. 6d. Cable stocks remain very steady. Great Northerns and Anglo-American preferred show moderate gains.

The idea of wireless telephony "cutting out" the cable service is treated with more politeness than attention. Every wireless scare in the past 20 years—and there have been many such alarms—has gone harmlessly over the heads of cable stockholders. Experience has, so far, demonstrated that plenty of room exists for both systems. Increased facilities have quickened the expansion of traffics, and, with the Eastern Telegraph Company taking an active hand in wireless work, the argument runs that the future can be viewed with equanimity, broadening into hopefulness, by the many investors who hold cable companies' stocks and shares.

We hear, incidentally, that the Eastern group handled 70,000 messages of greeting sent last Christmas under the scale of cheap rates offered by the companies.

In the manufacturing group, Henleys have strengthened to 87s. 6d., Brush ordinary and Metropolitan-Vickers ordinary to 26s. 9d. in each case, and Ever Readys to 4¼. The last-named touched 4¼, and the preference are up to 30s. India Rubber shares reacted to 20s. The handsome appreciations in the prices of Henleys, Callenders, British Insulated and Enfields, with a few others, have aroused discussion as to whether proprietors of such shares are likely to see their interests go higher. We have mentioned several times of late that profit-taking has played its part in the market, though ample support took readily what stock came in. The opinion may be ventured that current quotations admit of little scope for further advance; indeed, that they are over-valued when related to the very modest returns on the investor's money that the prices now allow. Callenders yield 4¼; so do British Insulated. Henleys pay 4¼, British Aluminium rather over 4. Better yields are obtainable from British Government securities available to strict trusts. But the holders and the present buyers of cable and allied companies' manufacturing shares are looking well ahead. It may be retorted that to-day's prices discount a great deal of expected prosperity in the future. They do; and, what is more, responsible Stock Exchange circles in touch for many years with the operations and growth of these companies, are calmly confident of the prices becoming both justified and higher. In the hills and the valleys of transitory changes, there may be falls in prices before the latter go ahead again actively. But the outlook for the future is held to be as bright as ever, and that this view finds serious favour is exemplified by the steadiness with which the prices hold what look to be unduly high levels.

Brazilian Tractions have continued their dramatic recovery, and are another 2 points up, at 112. The Brazilian Government bonds have returned to speculative popularity, and most Brazilian descriptions are in favour once more. British Columbia Electric Railway stocks have advanced, and a gain of a point lifted Anglo-Argentine Tramways 5 per cent. debenture to 68½. British Railway stocks are steady, and Undergrounds exhibit a further disposition to go ahead on dividend anticipations. Underground income sixes appear fully priced at their present figure of 104.

Iron, coal and steel shares are somewhat hesitant. Babcocks keep their price because the people attracted to this market, by the prospect of improved trade conditions, are discreetly choosing the best-class shares, for safety's sake. The rubber market is quiet, business having dropped back into a jogtrot groove after enjoying a spasm of animation last week.

Share List of Electrical Companies.

	Nom.	Dividend. 1924.	Dividend. 1925.	Price Jan. 17 1927.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.						
Bournemouth and Poole	£1	14	14	59/6	—1/-	4 14 6
Brompton Ordinary	1	10	10	25/-	—	5 12 0
Charing Cross Ordinary	1	15	15	25/-	—	5 12 0
do. do. 4½ Pref.	1	4½	4½	17/6	—	5 3 10
Chelsea	1	12	12	25/-	—	5 12 0
City of London	1	15	15	2½	—	... ...
do. do. 6% Pref.	1	6	6	23/-	—	5 4 4
Clyde Valley	1	8	8	28/6	+6d.	5 12 4
County of London	1	15	15	27/6	—	... ...
do. do. 6% Pref.	1	6	6	22/6	—	5 6 8
Edmundson's Ordinary	1	7	8	26/9	—	5 19 9
do. 7% Pref.	1	6	7	23/ xd	+½	6 1 9
Elec. Supply Corporation	1	10	10	30/6	—	6 11 9
Kensington Ordinary	1	15	15	24/-	—	5 16 8
Lancs. Light and Power	1	7½	7½	24/-	—	6 2
London Electric	1	10	10	24/-	—	5 17 8
do. do. 6% Pref.	6	6	6	6½	—	5 11 7
Metropolitan	1	11	11	28/-	—	5 7 8
do. 4½% Pref.	1	4½	4½	17/-	—	5 2 10
Midland Counties	1	5½	6	21/-	—	5 14 8
Newcastle-on-Tyne Ordinary	1	7	7	21/9	—	6 11 9
do. 5% Pref.	1	5	5	17/6	—	5 14 3
do. 7% Pref.	1	7	7	24/-	—	5 16 8
Notting Hill 6% Pref.	10	6	6	10	—	6 0 0
North Met. Elec. 6% Pref.	1	6	6	22/-	—	5 9 1
St. James' and Pall Mall	5	17½	17½	94/-	—	5 16 8
South London	1	15	15	24/6	—	6 3 0
South Metropolitan Pref.	1	7	7	1¼	—	6 3 0
Urban Ordinary	1	4	7	1/3	—	6 17 11
do. 6% Pref.	1	6	6	20/6	—	5 17 1
Westminster Ordinary	1	15	15	84/6	—	5 14 3
Whitehall Elec. Invst. 7½% Pref.	1	7½	7½	23/6	—	7 8 2
Yorkshire Elec.	1	8	8	27/-	—	5 18 6
HOME RAILS.						
Central London Ord. Assented	Stock	4	4	70	—	5 14 4
Metropolitan	,,	5	5	65	+½	7 18 10
do. District	,,	5½	5½	68	—	6 1 9
Underground Electric	£1	Nil	Nil	13/6	+6d.	Nil
do. do. Income	Bonds	6	6	104	+1	*5 15 8
TELEGRAPHS AND TELEPHONES.						
Anglo-Am. Tel. Pref.	Stock	6	6	101½	+½	5 18 3
do. Def.	,,	1½	1½	25	—	6 0 0
Automatic Telephone	1	3	10	2½	—	3 12 9
Chili Telephone	5	5	5	6½xd	—	4 12 4
Cuba Sub. Ord.	10	5	5	7	—	7 5 6
Eastern Extension	10	10	10	173½xd	—	*5 13 4
Eastern Tel. Ord.	Stock	10	10	174½xd	—½	*5 14 7
Globe Tel. and T. Ord.	10	10	10	18½	—	*5 6 8
do. do. Pref.	10	6	6	11	—	5 9 1
Great Northern Tel.	10	22	20	27	+½	7 8 2
Indo-European	25	9½	10	47½	—	*5 5 10
Marconi	1	10	Nil	16/9	+3/-	... ...
Marconi-Marine	1	10	7½	1½	—	6 13 4
Oriental Telephone Ord.	1	12	12	2½	—	*4 18 4
United R. Plate Tel.	5	8	8	8½	—	*4 15 6
Western Telegraph	10	10	10	17½	—	*5 16 0
HOME AND FOREIGN TRAMS, &c.						
Anglo-Arg. Trams First Pref.	5	5½	5½	2½	—	9 11 4
do. do. 2nd Pref.	5	6	6	2½	—	10 8 8
do. do. 5% Deb.	Stock	5	5	68½	+1	7 7 2
British Electric Traction Ord.	,,	7	8	144½	—	5 10 9
do. do. 6% Pref.	,,	6	6	109	—	5 10 1
Brazil Traction	100	4	5	112	+2	4 9 3
Brit. Columbia Elec. Rly. Pcc.	Stock	5	5	87½xd	—	5 14 3
do. do. Preferred	,,	9/-	12/9	121½	+1	*5 3 11
do. do. Deferred	,,	12/6	8	151½	+2	*5 5 7
do. do. Deb.	,,	4½	4½	79½	—	5 8 3
London & Sub. Trac. 5% Pref.	1	2½	Nil	7/-	—	Nil
London United Tram. Deb.	Stock	4	4	42½	—	9 8 4
Mexico Trams, 5% Bonds	—	5	5	64½	—	7 15 0
Mexican Light Common	100	Nil	Nil	32½	—	Nil
do. Pref.	100	Nil	Nil	76½	—	Nil
do. 1st Bonds	—	5	5	63½	—	7 17 6
Yorkshire (West Riding)	1	5	—	12/6	—	... ...
MANUFACTURING COMPANIES.						
Babcock & Wilcox	1	12	12	53/9	—	4 16 8
British Aluminium Ord.	1	5	10	45/6	—	4 1 6
British Elec. Transformer Pref.	1	Nil	7	18/9	—	7 18 5
British Insulated Ord.	1	15	15	70/-	—	4 5 9
Brush Ord.	1	10	10	26/9	+6d.	7 9 4
Callenders	1	15	15	3½	—	4 5 9
do. 6½% Pref.	1	6½	6½	23/9	—	5 9 5
Crompton Ord.	1	Nil	Nil	10/-	—	... ...
Edison-Swan	£/-	10	10	10/-	—	4 0 0
do. 5% Deb.	Stock	5	5	84	—	5 19 1
Electric Construction	1	10	15	31/3	—	5 8 0
Enfield Cable Pref.	1	7½	7½	1½	—	5 6 4
English Electric	1	5	Nil	12/-	—	... ...
do. do. Pref.	1	6	6	17/6	—	6 17 3
Gen. Elec. Pref.	1	6½	6½	23/6	—	5 10 8
do. Ord.	1	5	7½	31/6	—	4 15 3
Henley	1	15	20	4½	+¼	4 11 4
do. 4½% Pref.	5	4½	4½	4½	—	5 6 6
India-Rubber	1	5	5	1	—⅛	*5 0 0
Johnson & Phillips	1	10	17½	3½	—	5 19 1
Met.-Vickers Ord.	1	8	8	26/9	+6d.	5 19 8
do. Pref.	8	8	8	9½	—	5 16 4
Siemens Ord.	1	7½	7½	1¾	—	4 15 0
Telegraph Construction	12	20	10	23½	—	*4 1 4

*Dividends paid free of Income Tax.

The Physical Society's Exhibition.

Annual Display of Electrical Instruments and Scientific Apparatus.

(*Continued from page 71.*)

Igranic Electric Co., Ltd.

Primarily intended to provide anode voltage to wireless receivers by obtaining the supply from a.c. mains, the recently improved Igranic units are made in three patterns, all intended to operate at 110 or 220 volts at 40 to 60 cycles. One model, fig. 11, has a maximum output voltage of 200 with tappings at 35, 50, 65, 100, 120, 180, and the full 200 V. Three

Fig. 11.—De Luxe H.T. Mains Supply Unit, showing Tapping Points.

tapping plugs are provided so that different voltages may be obtained to suit various valves in a receiver. An "on-and-off" switch is provided, and a ruby lamp indicates when the unit is operating. The second model has a maximum output voltage of 120, with tappings at 20, 30, 40, 60, 80, 100, and the full 120 volts. Two tapping plugs are provided and an "on-and-off" switch, but no indicating lamp. The third model has a maximum output of 70 volts, but no tappings, as it is possible to select suitable valves so that all receive the same anode voltage. They employ full-wave rectification.

The filament units are designed to operate off a.c. circuits at 110 or 220 volts at 50 to 60 cycles, and can be arranged for delivering current at 2, 4 or 6 volts. The current output will be sufficient for multi-valve receivers.

The "Neutrosonic Seven" receiver, fig. 12, is particularly compact, combining the advantages of the neutrodyne and superheterodyne principles. The receiver itself is contained in a black leatherette-covered carrying case, and the batteries are accommodated in a similar, but smaller, case. A flexible armoured lead fitted with a special plug enables the battery box and receiver to be connected rapidly and easily. The outfit is suitable for those requiring a powerful receiver suitable for use with a frame aerial which is readily portable, and yet equally suitable for home use. The short-wave tuning unit, also on show, with the interchangeable units obtainable for use with receivers built from the super-heterodyne outfit, gives the complete receiver a tuning range of approximately 40 to 3,500 metres. Amongst the smaller components exhibited the new peep-lamp indicating plug is designed for use in conjunction with an Igranic-Pacent jack as a means of switching the receiver "on" and "off" and indicating when the receiver is "on" by the lighting of the lamp. Other exhibits included a comprehensive range of components, amongst which was the neat frame aerial shown in fig. 13.

Fig. 12.—Igranic "Neutrosonic" 7-valve Receiver.

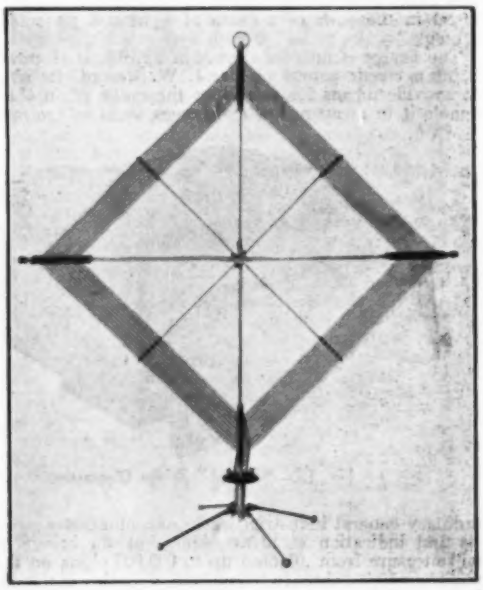


Fig. 13.—A Neat Frame Aerial.

Watson & Sons (Electro-Medical), Ltd.

This company's display included a "carboscope," a commercialised X-ray apparatus for examining the quality of coal. It consists of a tank containing the high voltage transformer immersed in oil, and in the same tank is arranged a self-rectifying Coolidge tube, also oil-immersed; the rays are focused upwards through a small window on the bottom of a shallow wooden drawer in which the specimens of coal to be examined are placed. Above the drawer is the fluorescent screen which is viewed from without by the aid of a tilted mirror. The tank and mirror afford ample protection, and control is by means of a single exterior contact. Very fine stereoscopic pictures have been taken by this apparatus, which should be of the utmost service for the examination of fuel for large central stations. The De-Lavel Watson oil-testing apparatus is, in effect a h.p. transformer giving easy graduations of pressure up to 70,000 r.m.s. volts by the agency of choke control arranged to electrify an oil-immersed gap. The gap can be set at the requisite distance, and the glass receptacle is then filled with the oil to be tested; the break-down pressure is read on a voltmeter on the outside of the apparatus, conveniently arranged over the control wheel. The metal casing lid is arranged to break the primary circuit when open, thus eliminating any possible danger of shock when filling the oil container.

Various Coolidge X-ray tubes were on view, and a series of radium ores with various appliances for storing, handling, and applying therapeutically the salts obtained therefrom; also a cadmium photo-electric cell for measuring ultra-violet radiation intensity. The radiations are allowed to fall on a plate within an evacuated glass cell the walls of which are cadmium covered, the window of entrance being of quartz. The intensity of the ultra-violet radiation is proportioned to the time taken for the loss of charge of the previously electrified plate, the electrification being measured by an aluminium-leafed electroscope. The Watson ultra-violet lamp was primarily designed for medical work, but is equally suitable

for use in a laboratory where a constant supply of ultra-violet radiation is required.

Cox-Cavendish Electrical Co. (1924), Ltd.

A selection of electro-medical instruments, such as diathermy apparatus, a simple portable photometer for gauging the intensity of ultra-violet rays, and goggles for use with lamps producing such rays. Of actino-therapeutic interest was a demonstration of the latest type of open tungsten arc lamp for ultra-violet radiation, popularly known as artificial sunlight, together with an improved quartz mercury-vapour lamp,

Fig. 14.—"Sunbeam" Portable Ultra-Violet Arc Lamp.

and a clinic type, combination open tungsten and carbon arc lamp. A new portable, impregnated, cored, carbon-arc lamp for home use, or microscopic illumination, was shown for the first time. This "Sunbeam" lamp (fig. 14) is arranged to work off d.c. and a.c. mains (approximately 100 to 200 volts) and is provided with a length of flex and plug adaptor; the current consumption is 3.5 amps. The light weight (2.5 lb.) and inexpensiveness of this outfit should appeal to the electrical trade.

Record Electrical Co., Ltd.

Apart from minor improvements in standard designs, the company this year introduced two improved instruments.

One novelty was a range of skeleton instruments suitable for demonstration purposes; they consist of the well-known "Cirscale" and "'xtra" type moving-coil and moving-iron ammeters and voltmeters mounted on a wooden base with transparent dials and enclosed under a glass cover, with front connection terminals attached to the wooden base. The object of the series is to enable the lecturer to explain the construction of various types of measuring instruments in everyday use to his students, all the important parts being easily visible through the glass case. The instruments are actual working models and can therefore be put to practical use in the laboratory and the student can watch the movements of the parts whilst the current is on. The transparent dial enables observers on both sides of the lecture table to read the indications of the pointer; furthermore, the scale can be stood in the path of a beam of light and projected on to a screen.

The bridge ohmmeter shown in fig. 15, is of novel design, being a recent patent of Mr. J. W. Record, its object being to provide means for extending the range of an ohmmeter to enable it to measure low resistances, such as are met with in

Fig. 15.—"Record" Bridge Ohmmeter.

ordinary general industrial work. An ohmmeter usually gives its first indication at 10,000 ohms, but the bridge ohmmeter will measure from .01 ohm up to 999,900 ohms on the bridge, and from 10,000 ohms to 100 megohms on the ohmmeter scale: it also indicates a short circuit (zero) or open circuit (infinity). The instrument consists of a generator, a direct-reading ohmmeter convertible into a galvanometer for bridge tests, a decade resistance box with ratio switch in one arm of the Wheatstone bridge, and a multiple-contact switch for changing connections, all arranged in a portable carrying case. The indicating unit is the same as that employed in the Record ohmmeter patented in 1902; constructional improvements, however, have been effected—chiefly the use of cobalt steel and a combination of resistance bobbin and dust shield, all forming a complete unit. The magnetic field for the pressure and current coils is provided by the same magnets, so that any loss of field strength due to diminishing magnet strength, or any change in temperature, would affect both coil systems equally, and as the pointer takes up a position which is the resultant of these forces, its true indication would be unaltered by such changes. Immunity from stray magnetic fields is effected partly by compensation as above and finally by shielding; the generator is also provided with cobalt-steel magnets, and its handle is an entire departure from the usual folding knee joint pattern.

H. Tinsley & Co.

Besides scientific instruments, a model was exhibited of Mr. Galletti's radio "beam" transmitter. The actual transmitter could be seen in operation by appointment at Hendon, but the model illustrated the principle upon which the transmitter works. It is capable of sending out an actual beam of radiation of radio-wavelength exactly like a searchlight, and not in the same way as the angular wedges of radiation are sent out by the "beam" stations at present working. Thus the beam can be directed upon a given target and limited both vertically and horizontally; the angle of the beam is negligible.

It will be realised that this is a very remarkable achievement, of which the future possibilities are large indeed. The actual apparatus at work at Hendon is operating on 4-metre waves, which could be varied without affecting the principle of the transmitter. The beam responds to all the optical laws of reflection and interference.

Amongst other items was a frequency bridge, built according to a suggestion of Dr. Pedersen, of Copenhagen, which has the unusual advantage of being suitable for low as well as high frequencies. The circuit employed is the well-known non-inductive combination of a resistance and a condenser in parallel with a resistance and an inductance; the frequency is measured by balancing the e.m.f. upon one of the resistances against the secondary of the mutual inductance, in series with the combination. The bridge shown had three ranges, which are obtained by three tappings on the mutual inductance, reaching from zero to 5,000 cycles, zero to 2,000 cycles, and zero to 1,000 cycles. Great latitude in the available frequency range is obtainable, and the bridge can be adapted for the measurement of quite low frequencies if required, as the square root of the resistance on the adjustable dial.

Hoope's conductivity bridge has been specially designed for for the convenient measurement of the percentage conductivity of copper samples. It is a Kelvin double bridge in principle, the sample being measured against a copper standard of the same nominal size: the procedure is to cut a specimen in the special cutting-off machine to a known length and to weigh the specimen against a special weight, the difference in weight being noted. The specimen is then put into the bridge and the "difference of weight" dial set to the value found when weighing. The slider of the bridge is then adjusted for balance and the percentage conductivity read directly upon the scale. The weight against which the copper sample is balanced is so adjusted that the percentage conductivity of the standard, as well as the dimensions of the standard, are compensated for, so that no further correction is required; there is a separate weight for each standard. Since measurements are made against copper, the temperature coefficient of the sample is compensated for, and measurement can be carried out without any rigorous temperature control; an accuracy of 0.1 per cent. is obtained.

A four-phase tuning fork has been developed to produce a continuous torque phonic motor. By means of a special type of contact, the fork is made to pass impulses of current displaced 90 deg. in time phase; the duration of these impulses can be controlled with great facility by the adjustment of the contacts. The fork exhibited was of a double type, provided with two pairs of limbs, one pair vibrating 180 deg. out of phase with the other set, both maintained by the same fork, so that a great many phased contacts can be obtained; there were five contacts on the fork exhibited, but several more can be added if required.

A number of N.P.L. pattern low-resistance shunts of wire construction were exhibited for the first time: the wire has the advantage of greater homogeneity than rolled sheet manganin, and shunts for carrying up to 16,000 amperes are under construction in this type. A curve-tracing machine of the "Ondograph" type, suitable for commercial frequencies, was shown operated by a tuning fork. A reflecting dynamometer specially designed for the measurement of zero power factor is intended for use in establishing quadrature in such measurements as dielectric losses; its sensitivity is such that, with full-range current, a power factor of 0.00013 can be detected. The instrument is provided with four current ranges, so as to make it suitable for a wide variety of tests. A submarine cable balancer (D. C. Gall's adjustment restorer) is designed to measure the errors in the duplex balance of submarine cables, the balance being obtained by operating the dial of the instrument. The settings of the dials give the resistance and reactance errors, a series of determinations of which is made at a number of frequencies, and from the nature of the errors, adjustments can be made by the artificial line, which will eliminate them. The position at which the adjustment to the artificial line must be made is found by means of a special chart, which was also exhibited.

(To be continued.)

Electric Railway Track Equipment.

A Comparative Review of the Electrical Apparatus installed on the London Underground Lines, and Experience Gained in their Operation.

By ARTHUR R. COOPER, M.I.E.E.

(*Abstract of a paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

(*Concluded from page 75.*)

Conductor rails endeavour to move or creep in the direction of the traffic, even on up-gradients, due to the effect of the train shoes and of the variation in temperature. These effects have been responsible for the over-turning of rails in many cases. Various types of insulators have been designed to act as anchors, but the best results have been obtained with a giant strain insulator, fig. 6. This is fixed at one end to a strap bolted to the underside of the rail, and the other end is secured to a sleeper by means of a strap fastened to the top of the sleeper and turned down over its side. The present practice for new lines is to install anchors, on the average, 300 yards apart.

Experiments are being made on a special joint for taking up conductor rail movement, fig. 7, and observation extending over 12 months shows that a daily movement up to 1¼ in. is recorded, the joint providing for movement up to 4½ in.

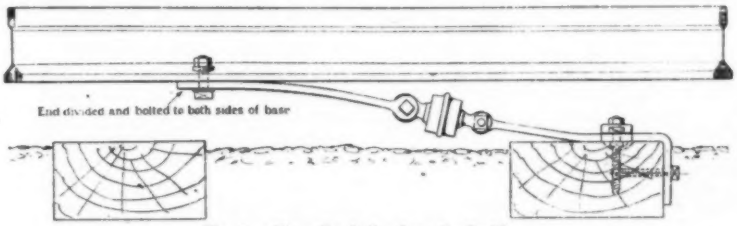


Fig. 6.—Giant Strain-Insulator in Position.

Failures have occurred with the earlier jumper cables laid direct in the ground at junctions and other places where gaps occur in the current rail, the cables being lead-covered and rubber-insulated. To overcome these failures it was decided to lay the cables in wooden troughs on the sleepers and above ground, the cable used being a special one with rubber insulation, having a covering of bitumen-rubber and being taped, braided, and compounded, but not lead-covered.

Cable connections to the conductor rails are made by flat lugs fixed with set-screws. An improvement made in recent years in such joints is the use of stainless steel in place of gunmetal for the set-screws; it is found that better connections result, apart from a clean surface being maintained.

The appearance of the rail is somewhat misleading, in that the heavy scaling would appear to indicate a much more rapid wastage than has actually occurred. The loss on the Underground Railways, due to corrosion and wear, varies from about 0.2 per cent. under favourable conditions to 1.2 per cent. under specially adverse conditions. The wear off the head of the rail is increased materially where moisture is present. It is suggested that a thin film of rust forms on the surface where moisture is present, and that this film is swept off by the train shoes and a clean surface left for a fresh formation of rust, and that as a result a much quicker corrosion effect takes place. Heavy loss from corrosion occurs at Earl's Court; it is suggested that vibration accelerates corrosion, and the amount therefore is dependent to some extent on the train service. In the tube tunnels the wear of the positive rails is about 0.08 lb. per yard per annum, and in the open 0.66 lb., or about 8 times as much.

It is interesting to note that positive rails wear a little more quickly than negative rails, and in particular where current is being collected. The wear on the conductor rails is also influenced by the weight of the shoe.

It is desirable to record a feature which has come to light in investigations on the loss of weight, and that is the extraordinary difference in the amount of wear that has taken place within the length of an individual conductor rail. The rail taken as an example is the worst one on record. The least vertical wear of the head is about ⅛ in. and the maximum depth of wear 1¼ in. These differences are about 20 ft. apart on the same rail, so that there can be no marked variation in chemical composition. Brinnell tests taken on the sections of rail cut out at these two places only showed that there was a slight difference in hardness. It is apparent that the painting of rails in the tunnels would not be justified. From experiments carried out on rails on the outside sections, the same conclusions have been drawn. To effectively stop corrosion by painting the rails would cost about £20 per annum per mile of rail.

For ordinary maintenance purposes the height of the current rail is hand-gauged by the permanent-way maintenance gangs who are responsible for keeping it to the standard level, the maximum variation permitted being ¼ in. up or down. Wood-packings fixed between the sleeper and the insulator are generally employed to adjust the height of the current rail. These are of creosoted pine for the open sections, and hard-wood for the tunnels. They are of sufficient size to take the insulator base and fastening clips, and are supplied in thicknesses from ¼ in. to ¾ in. Experience has shown that it is very necessary to bend, by careful "crowing," the rails installed on curves, to ensure that they are set properly to gauge.

The insulators originally installed on the outside sections of the District Railway were of two materials, some being of porcelain and some of a granite composition. They had a metal cap and a metal tripod base, as shown in fig. 8. The porcelain insulators have given little cause for complaint as regards insulating qualities, but a number of breakages have occurred almost entirely by crushing or breaking away at the jointing of the metal cap. In the type of insulator without a metal base this weakness still exists. The fractures have occurred with insulators having the centre lug on the metal cap cemented in, as well as where a flat cap is cemented on to the top of the porcelain. The breakages of porcelain and the desirability of doing away with the metal cap led to the introduction of the composition insulator, which has been found to be more robust, although experience has shown that some strengthening of the head or side lips is necessary; this has been provided by moulding in some metal reinforcement. The insulation under adverse

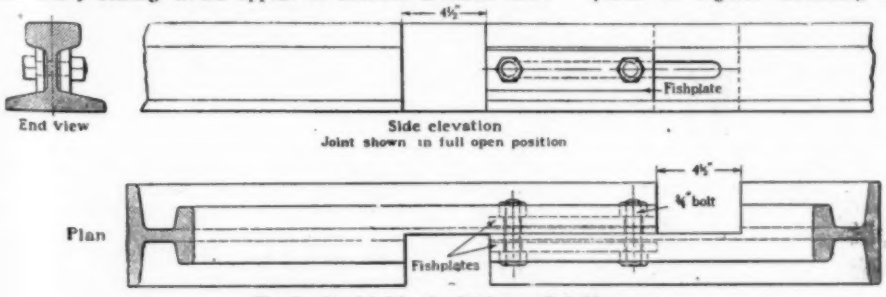


Fig. 7.—Special Joint for Taking up Rail Movement.

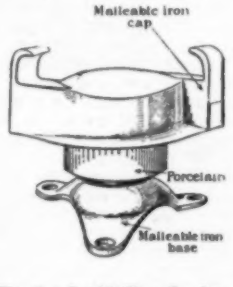


Fig. 8.—Outside-Type Insulator.

conditions is not so good as with porcelain, probably due to the less smooth surface. There is room for an insulator not requiring a separate cap and of a more robust nature than the porcelain or stoneware type of to-day, and yet possessing the smooth surface and insulating qualities of porcelain.

In doing away with the tripod base of the original type of insulator, it has been found necessary to obtain a more even surface on the sleeper top for the insulators to rest upon. Glass insulators with metal caps and metal-frame bases, but without petticoats, have been tried, but found to be too brittle; numerous breakages occurred. The use of insulators made from wood is not favoured, although good results were obtained from these insulators in the District Railway tunnels. They were used on the negative rail only and were dipped in hot insulating material. In tube tunnels earthenware insulators are used with moulded side-clips. This material is quite suitable for such conditions, and is cheaper, but is too absorbent for outside use. Insulators are installed at every third sleeper, 8 ft. or 9 ft., but it is general practice to provide an insulator on each side of the current-rail joints so as to lessen the tendency for vertical motion at the joint or rail-ends.

Some experiments have been carried out to determine whether the cost of cleaning insulators is justified, with the result that the practice has been discontinued. No case of short-circuit has occurred due to dirty insulators, and no ill-effects of any account can be traced to the small leakage currents which could be reduced during wet weather by cleaning the insulators. The value of the current lost is not a factor of any consequence.

Reference to the electrical equipment of the track would be incomplete without a description of the arrangements in force for cutting off the current from the track in emergency. Short-circuiting bars are carried on each tube train. These consist of an arm with a clip at one end to fit over the negative rail. The arm is arranged to pivot in this clip, and a conductor is arranged along the arm to connect to a contact so placed at the other end that it will fall on to the rail as the arm pivots; a wooden handle is provided on the arm. This device is placed across the rails after current has been taken off by a special device for making dead any section of the track in tube tunnels at a moment's notice. Two bare tinned-copper wires, tunnel lines, are run throughout the tunnels on insulators and at a height convenient for the train staff to reach. When these wires are short-circuited the circuit breakers at the sub-station relating to the section in question are opened automatically by relays. Provision is further made that the train staff, by attaching to these wires the portable telephone carried on all trains, can speak to the sub-station operator, giving particulars of the reason for switching off the current.

As forming part of the arrangement in connection with taking off current, relays have been installed across the conductor rails to switch on automatically the general tunnel lighting when the current rails become dead. The tunnel-lighting circuits are fed from the a.c. station lighting supply and are in general use during non-traffic hours for maintenance requirements. As a further arrangement, in each car of a train two small lamps are provided which, on the current rails becoming "dead," automatically light up from a battery on the train.

Interruptions to train working on account of ice or snow on the conductor rails occur on an average only about once or twice each year, but they are serious in effect. Snow itself does not prevent the shoes from collecting current, the trouble arising from a film of ice on the rail. The methods in general use to overcome this difficulty are mechanical. The most successful form of apparatus used up to the present is a steel strip brush fitted to a proportion of the motor-cars. The details of construction are shown in fig. 9, from which it will be seen that a raising and lowering device forms part of the equipment.

Experience has shown the need of exercising particular care with regard to the effect on the strength of materials of a burn from an accidental electric arc. On a steel rail the effect of an arc is practically the same as a nick, the burnt rail being easily fractured by a blow or similar shock. With regard to this effect on rails, an investigation was carried out some few years ago. A number of pieces were cut from the same length of rail, and in each case one piece was tested untreated and the other pieces were electrically burned and tested in various ways. The results showed that the strength of a rail to withstand impact, when the burnt metal was in tension, was very much reduced; with the burn in compression little or no diminution of strength occurred; the effect of a burn was very similar to that of a nick, and annealing after an electric burn produced a tendency to restore the strength, but only to a very limited extent. It is the practice on the Underground Railways, when signs of electric burning are found on a track rail, to have the rail replaced. A similar rule is adopted with regard to axles on the rolling stock.

The adoption of the insulated return has undoubtedly reduced the likelihood of injury to cables, particularly those in the railway tunnels. Breakdowns on the h.p. cables have been very few and, in the majority of cases, have been caused by mechanical damage rather than by an internal electrical breakdown or damage to the lead covering by electrolysis. No system of marking on the site the presence of "Underground" cables has been adopted, reliance being placed on the rule that before any work of opening up is undertaken the staff responsible for the h.p. and l.p. cables is to be consulted.

The h.p. cables for the District Railway tunnels were originally laid in sheet-steel troughs 12 ft. long, these being supported at each end on cast-iron brackets fixed to the tunnel walls. It was subsequently decided, with the concurrence of the Board of Trade, to take down this troughing entirely and provide a bracket support every 4 ft. No ill-effect of supporting old unarmoured h.p. cables in this way has been experienced.

In the open sections unarmoured lead-covered cables were originally laid in earthenware ducts a few feet in the ground, the ducts being surrounded with concrete. Some defects have taken place due to subsidence of these ducts, as well as from electrolysis in wet places and from the presence of impure water. The cables in the ducts have in several cases had to be removed and erected on posts. In being unarmoured, these cables do not accord with the general practice on railways, but our experience, extending over a number of years, does not show any ill-effect. It is our practice on outlying sections to run all new cable armoured, but the additional expenditure, about 20 per cent., is not justified where the cables are free from trespass.

Cables over bridges were originally carried in 4-in. wrought-iron pipes, no special steps being taken either to earth the lead covering of these cables or to insulate them from metallic structures. Some replacement of the cables has been necessary on account of cracks in the lead sheathing caused by vibration. The pipes are gradually being taken out, and where the cable is serviceable it is supported on raw-hide hangers provided at about 3 ft. spacing.

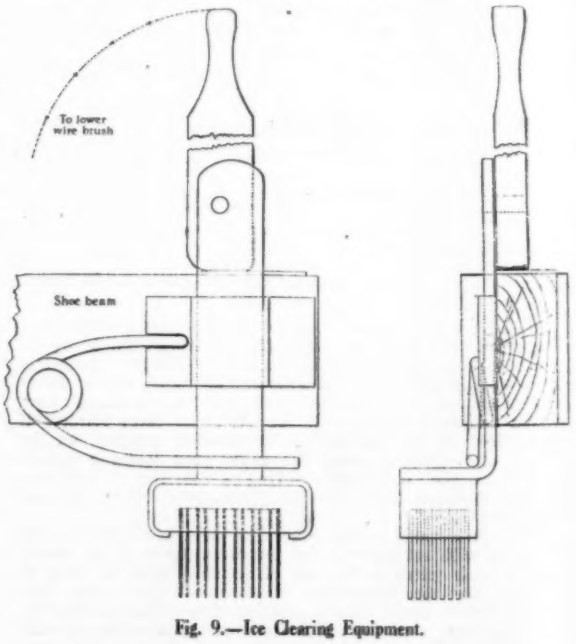


Fig. 9.—Ice Clearing Equipment.

On the tube railways the h.p. cables are unarmoured, and are supported from the iron tunnel lining on cast-iron brackets. On the railways where the insulated return has been adopted, no bonding either of the cables to the tunnel iron, or of tunnel iron to tunnel iron to make it continuous, has been carried out, and no steps have been taken to keep the lead separate from the tunnel lining.

At points where sub-station feeder cables are connected to the rails short jumper cables are kept, with the necessary means for quick attachment to the conductor rails should a failure occur on the cables between the sub-station and the conductor rails.

There are two special items of electrical equipment particular to tube railway speed restrictions. The first is a machine to record the speed of all trains passing over some predetermined point, and is used to check the proper observance of speed restrictions. The recorder can be fitted up for use at any place. The second machine, a speed indicator, shows a motorman the actual speed at which his train is travelling over a particular place just in the rear of where the indicator has been installed. For the speed recorder two pairs of electric contacts are clamped to the track rail about 50 ft. apart at the point where the speeds are to be recorded, and are operated by the passage of the train. The first contact starts up the pointer of the recording instrument, and the second causes marks to be made on the chart as the train wheels pass. The record is made on a paper strip 6 in. wide, driven at 6 in. per hour, by mechanism which also moves the timing pointer, this consisting of an arm passing across the paper once for each train

recorded. A small electric motor drives the recording arm and runs in synchronism with an electrically-driven tuning fork. The speed indicator consists essentially of a disk timing-device which is electrically released to rotate during the passage of a train over a measured section. The disk is pierced near the edge with numbers in decreasing order, and when it stops, as the train leaves the measured section, a lamp lights up and, by means of a small optical lantern arrangement, shows on a board an image of the number to which the disk has rotated and which naturally corresponds to the speed over the section. The measured section is about 180 ft. long, the indicator being placed about 200 ft. beyond this section. The rotation of the disk is carried out by a gravity arrangement assisted by a spring in order to increase the initial speed and thus allow of the numbers being evenly spaced round the disk. The rotation of the disk is controlled by the damping effect of the electric currents generated in it by its rotation between suitably-placed magnets. The disk is returned to normal by a simple electric motor device.

Both of these devices are worked from ordinary accumulators and, being portable, are frequently moved from place to place;; in fact, the recorder is generally moved after having been installed for about 24 hours on any one section. The use of these instruments has resulted in the much-improved observance of the speed restrictions.

Electric Ploughing.

A New Italian Development, employing a Double-Locomotive Equipment.

SOME particulars of what is described as the first electric ploughing outfit on the funicular or cable system of Italian manufacture have been given in the *Implement and Machinery Review*, whose permission we have to make use of the following information and reproduce the accompanying illustration. The makers of the equipment are Messrs. Fratelli Violati-Tescari, of Milan, and there are already many of the ploughs at work in Italy, where it is expected they will prove of great assistance in the campaign which has been instituted in that country to produce more home-grown fruit.

The equipment, which is admittedly modelled on the Fowler system, consists of two electric locomotives weighing about 55 cwt. each. They are four-wheeled vehicles, the two front wheels being the steerers. The frame is rectangular and of channel-section iron. The driving motor is of 36 h.p., and is placed on the forefront of the locomotive chassis; its speed, 800 r.p.m., is so reduced by a double set of gearing that the drum pays out or winds on slowly, up to less than 30 r.p.m. if necessary, so that the cable, which is 400 metres long, is wound on at a correct speed for the task in hand. One locomotive draws the plough or other implement as the drum of the second prime mover, running light, pays off the cable, and the reverse happens for the opposite run. The motor is suitably enclosed, and the transmission system is also protected, as is the winding gear. The sheet-steel cabin contains all the controls and the necessary instruments, and affords the operator a good view of the ploughing operations while fully sheltering him from the weather. The entire outfit is simply designed, permitting the use of wearing parts of ample strength without adding unduly to the weight, and the driving arrangements are conveniently arranged.

In a trial which took place at Rogoredo, a plough was operated at 500 V, the supply pressure of the district, and there was no need to use the portable transformer, which is supplied with the set for making the necessary pressure adjustments. The soil conditions were superficially favourable, but the draft was increased not so much by the matted top growth as by the dry and hard subsoil of land that had not usually been deeply worked. A four-furrow balance plough was hauled along at a rate of 2¼ miles per hour, and had an effective working width of about 4 ft. The operation was regular and uniform throughout, there not being a single hitch in the free flow of movement from bout to bout. The depth of the work was also well maintained throughout at approximately 10½ in.

The price of the apparatus is said to be about a third of that of a steam ploughing set. The equipment is capable of ploughing, it is claimed, about eight acres of ground, under the conditions which prevailed at the trial, in a ten-hour day with an effective power of 30 h.p. The necessary personnel is three men, one on each locomotive and one on the implement, though where a bigger implement is used and more work undertaken in the course of a day it might be necessary to supplement the crew. The average life of the outfit, with the exception of the cable and certain accessories, is placed at from 15 to 20 years, and where a working knowledge of the plant is used to advantage in protecting the delicate electrical apparatus from rust and water, the maintenance costs are reduced to a very low figure. It is claimed that the total cost for ploughing 2¼ acres is about 16s., where the cost of energy is about 0.65d. per kWh.

Double-Locomotive Electric Ploughing Equipment.

It is interesting to note that the makers produce other electric ploughing sets ranging from 35 to 100 h.p., and that they have turned out some 350 of such sets in 10 different types. These include an electric prime-mover much on the lines of the double set mentioned above, but arranged for working on its own with an anchor placed at the far end of the field. Two drums are fixed horizontally in the middle of the chassis, and one of these pays off as the other draws on while the implement is hauled to and fro.

Hollow Electrical Conductors.

An Economical Means of Reducing Corona Loss.

NOTWITHSTANDING the fact that corona loss has been studied sufficiently to enable engineers to develop the transmission of power electrically by means of overhead conductors operating at pressures up to 220,000 volts, research is constantly in progress with the object of improving the efficiency of conductors.

The solution of the problem has hitherto generally been sought by the employment of a conductor of a diameter large enough to confine corona loss within tolerable limits. In the case of the highest-voltage transmission lines, however, such a policy often involves the use of more material in the conductor than would otherwise be economical. It is, of course, unnecessary to make the conductor solid; it may be stranded and wound round a core of some other material, either insulating or metallic, thus increasing the total diameter. Such a composite cable, however, introduces difficulties: its cost and weight may be increased, and in

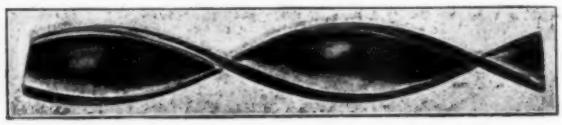


Fig. 1.—Cylindrical Core, Twisted Copper Strip of I-section.

some cases its use may necessitate the provision of extra strong towers and foundations; the core material may deteriorate according to climatic conditions, whilst differences between the coefficients of expansion of the conductor and core materials result in varying stresses with temperature changes, which may reduce the combined strength and cause alternate tightening and loosening of the conducting strands on the core, with the result that the surface-conducting metal tends to "crawl" towards the lowest point of the span sag, with the possible consequence of the conductor strands fracturing at their points of support.

In order to obtain cable of the desired diameter without the difficulties enumerated above, the Anaconda Copper Mining Co. and the American Brass Co. have introduced hollow cables, which are so constructed that their outside diameter and cross section are independent within wide limits, it is claimed, thus permitting transmission lines to be designed for maximum economy as regards both corona and resistance losses. Moreover, such cables are said to be advantageous for carrying alternating currents of such magnitude as to make the "skin effect" important.

Hollow conductors may be constructed in various ways: for the sizes required to accommodate the transmission voltages so far "standardised," the most rugged and economical design is claimed to consist of a core made by twisting around its longitudinal axis a copper strip I-section in shape (fig. 1). The web part of the strip at any section remains perfectly straight, giving a rigid column across the diameter of the cable, while the flanges provide a bearing surface for the strands laid around the core to form the cable. This I-section of copper can be twisted more or less closely as required to support the strands, and forms, in effect, a light-weight flexible cylindrical core capable of withstanding considerable compression and supporting the surrounding strands at short intervals. The first layer of strands is spiralled in the opposite direction to that of the core strip; successive layers can be spiralled alternately in opposite directions as in the construction of concentric cable.

The strength of such a cable is that of the strands, plus the strength of the core, and its conductivity is the conductivity of the strands, plus that of the core. The core in a cable approximately 1 in. in diameter and 500,000 c.mils will not be more than 7 per cent. of the total weight of the cable, and its conductivity will be about 90 per cent. of the conductivity of a solid copper wire of the same weight per foot. The conductivity of the complete cable will therefore be over 99 per cent., and the tensile strength approximately the same as that of a concentric cable of the same weight per foot. Whenever the cross section of copper required to carry the current economically does not give the desired tensile strength, the hollow conductor can be reinforced with bronze strands having the same temperature coefficient of expansion as copper, so that the strength of the combination cable does not change with temperature.

In January, 1925, a 500,000-c.mil "Anaconda" hollow-conductor line was installed by the Montana Power Co., near Great Falls, Montana. The operating engineer reported later that "On September 19th, 1925, our hollow-conductor line withstood, without the slightest deformation, the most severe wet snow and ice storm which this territory has experienced in twenty-five years. The adjacent spans of 1/0 copper were broken down by the snow, and there were twelve breaks within a distance of approximately five miles. Other lines in the neighbourhood of Great Falls were seriously broken down by the storm. We also had over 100 miles of telephone line laid flat on the ground." The cable in question was erected by the regular line crew without additional help, or supervision . . . "It was more flexible and, of course, lighter than a stranded conductor of the same diameter; it ran through the blocks without any difficulty whatever, and there was no tendency for the cable to crush or fray."

A hollow conductor can be handled and erected in the same manner as a concentric cable, except that it is necessary for the sheaves over which it is pulled to be made with grooves which closely fit the outside diameter of the cable; all clamps, both suspension and dead-end, should have accurately-fitted, smooth-bored surfaces. A 5-ton solid rubber-tired motor truck with a load of 2 tons was run over such a cable laid on concrete, several times, without damaging it. Such conductors can be furnished bare; paper insulated and lead sheathed; and varnished-cambric insulated, either lead sheathed, or braid covered.

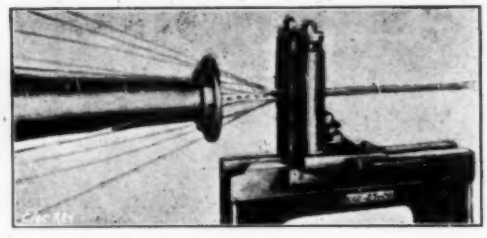


Fig. 2.—Stranding Wire Over Copper Core.

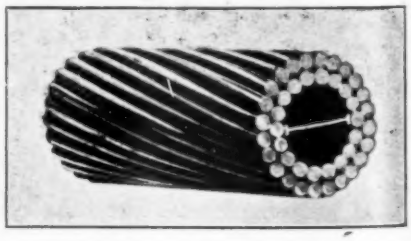


Fig. 3.—"Anaconda" Hollow Conductor.

Rural Electrification in Ontario.

A Canadian correspondent says that the year just drawn to a close has been marked by a great expansion in the use of electric power in Canada. In no respect has this development been more pronounced than in the rapid extension of this service in the rural districts of Ontario, where approximately 18,500 farms are now being supplied with power by the provincial Hydro-Electric Power Commission, the operations of which probably cover a larger territory than those of any similar organisation. The Commission has already constructed 2,240 miles of rural transmission lines, of which 700 miles were erected during 1926, supplying about 5,000 new customers. The plans of the Commission involve a considerable further widening of this field of its operations, by the extension of the system at the rate of about 600 miles of transmission lines per annum for some years to come. Farm consumers at present are using about 8,000 h.p., and when the objective of the Commission is attained, it is estimated that about 20,000 h.p. will be required. These figures, it may be noted, are for the *bona-fide* farms, and do not include the suburban areas near the large cities. The contracts for power are made with the townships in which the farms are situated, which are held responsible for the payment of all charges. The introduction of electric light and power has done much to lighten the labour and increase the efficiency of the farmers, as there is a wide range of services on the average Ontario farm to which electricity can successfully be applied.

Selected Radio-Telephone Apparatus.

Recent Developments and Improvements.

New 6-V "DE" Valves.

We have received samples of two new valves, one of which is illustrated in fig. 1, which are the first of the 6-volt class to be issued with the new Marconi nomenclature. As their names imply, the DEH.612 and DEL.612 are high- and low-frequency types respectively, having a filament consumption of 0.12 amp. The characteristics of the former, fig. 2, show that it is a good detector and suitable for resistance or choke-

Fig. 1.—New DEH.612 Valve, 6 Volts.

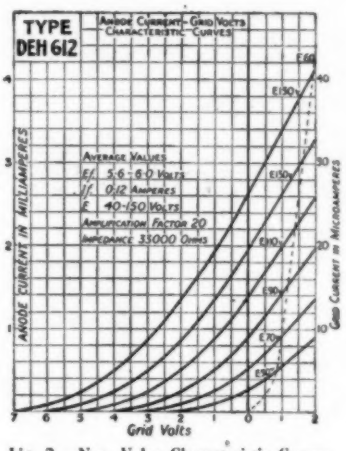


Fig. 2.—New Valve Characteristic Curves.

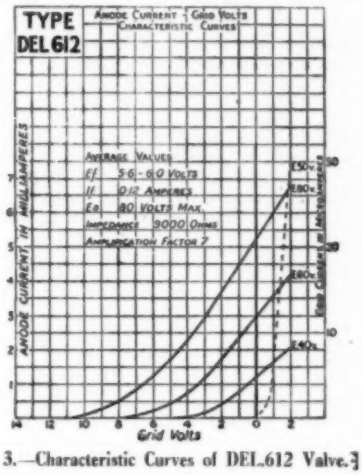


Fig. 3.—Characteristic Curves of DEL.612 Valve.

capacity coupling, or high-frequency stages. The latter, fig. 3, is suitable for use in the first stage of a transformer-coupled amplifier, and with 80 volts on its plate will need about 4-volts grid bias; it may also be used in the second stage when only moderate output is required. Both valves represent excellent value, and their chief constants are shown in figs. 2 and 3. These valves are manufactured by the M.O. Valve Co., Ltd., and similar ones are being marketed by the General Electric Co., Ltd., under the name of "Osram." They offer all the advantages of the 6-V filament, taking 0.12 A only, for the same price as 2- or 4-V general-purpose valves, another step towards economy.

Battery Eliminator Components.

In view of the extraordinary interest which has been aroused by the introduction of high-voltage plate-battery eliminators

Fig. 4. G.E.C. Battery Eliminator Set.

to the wireless market, it is gratifying to learn that a full set of components, specially manufactured to enable the constructor to build up his own unit, can be bought for use in conjunction with a.c. circuits. This enterprising move has been made by the General Electric Co., Ltd., which also supplies assembled units, in attractive containers, for a.c. in 100/115-volt and 200/230-volt types, and for d.c. As the components, in the case of the a.c. units, are similar in every respect to the individual components now being sold separately, there would appear to be no valid reason why equally efficient and serviceable units should not be constructed by those who prefer to build up their own eliminators; moreover, the circuit for which they are designed is at the constructor's disposal, permitting him to assemble them in accordance with his own requirements. The components in question embrace a transformer, choke unit, condenser-bank unit, fixed resistance, regulating resistance, "Osram" GR.1 rectifier, "Osglim" voltage-regulator and lamp holders, each of which can be acquired separately, or the whole kit complete, as detailed (fig. 4).

A New "PM" Valve.

The valves used in a resistance-capacity coupled amplifier should have a higher amplification factor than those used for a transformer-coupled amplifier. Such a valve is the new Mullard PM.5B, whose amplification factor is 37 approximately, or 30 overall per stage in practice when correctly used, which value is nearly as high as that obtainable from the best transformer amplifier, it is claimed, but with superior quality: the new PM.5B valve has the very low impedance of 74,000 ohms. It must be emphasised that in a multi-stage amplifier, the amplification over two stages may be as high as 1,000 and therefore it is important that the valves used in the later stages must have a sufficiently long "grid base" to avoid the "cut off" effect which causes bad distortion in l.f. amplifiers. The anode current flowing when the grid is at zero potential, should be halved by the application of the negative grid bias. Other characteristics of the new valve are filament voltage from 5 to 6 volts and current 0.1 amp.; the maximum anode voltage is 150 volts and total electron emission 20 mA, while the mutual conductance is 0.50mA-volt (at anode volts = 100, grid volts = zero).

The Condenser Telephone.

A lecture on "The Condenser Telephone: a Development of the Speaking Condenser," was delivered to members of the Royal Philosophical Society of Glasgow last week by Dr. George Green, Lecturer on Natural Philosophy at the University, who explained that the idea of employing condensers as mechanisms for converting electrical vibrations into sound vibrations was by no means new, but none of them had been able to survive the competition of the ordinary electromagnetic telephone. Interesting demonstrations were given by the lecturer, whose experiments proved that the condenser telephone was capable of giving volume of sound as well as quality in transmission work. By means of condenser telephones of various capacities and having plates made of different materials, the tuning of the condenser telephone was demonstrated. The quality of the instrument improved and the volume of sound emitted also increased as the capacity was increased. Instruments of high capacity were apparently best suited for the reproduction of music. The lecturer pointed out that the condenser telephone was capable of being used either as a transmitter or as a receiver.

The Use of Low-Grade Fuels.

A Comparison of the Methods of Burning High Ash-and-Moisture-Content Coals for Steam Generation; Chain Grate Stokers *versus* Pulveriser Equipment.

By W. F. GOODRICH, M.B.E.

(*Abstract of a Paper read before the* INSTITUTION OF FUEL ECONOMY ENGINEERS.)

UNDER the conditions of acute coal shortage which have prevailed during the past few months, large quantities of low-grade coal have been used. It is not suggested that the users have been generally very enthusiastic, either in regard to its cost, calorific value, composition, or the results obtained, but its use has undoubtedly enabled many steam users to carry on. Opinions will widely differ as to what fuels may reasonably be placed within the category of "low grade," but the author would submit that the following may all for one or more reasons be classed as low-grade fuels: Coal having a calorific value "as received" of 10,000 B.th.u's or less; coal having an ash content of 20 per cent. or upwards, coal and coke dust; slurry, gum, duff, smudge, dant, pond tank or washery settlings, ballast, bats, and pickings; town's refuse; certain waste gases; timber, wood waste and sawdust peat; brown coal and lignite; and bagasse.

In a paper entitled "Notes on the Use of Low Grade Fuels in Europe," by R. H. Fernald, issued by the United States Bureau of Mines eleven years ago, the position in the United States at that time, in so far as the use of low-grade fuels was concerned, was referred to thus:—"The unrestricted use of our better grades of fuels and the ruthless waste and neglect of fuels which should be of real commercial value, are phases of our national extravagance which are but little short of appalling." Whether the United States can afford to neglect to utilise those fuels which are described by Mr. Fernald as "of real commercial value" is a matter for those concerned to decide. Our position, however, is entirely different, and it may without any hesitation be stated that we cannot afford to neglect to use any fuel of real commercial value. It would seem that the only hope of cheaper coal in the future is dependent upon the much more extended use of low-grade and so-called waste fuels; and the drastic reorganisation of the coal mining industry. It is idle to disregard the fact that as a whole the coal mining industry has functioned wastefully and inefficiently; and it can scarcely be denied that drastic changes must be made. All authorities are agreed that underground and surface waste of coal at collieries represents a colossal loss in revenue, a loss which has been and still is discreditable to all concerned.

Generally speaking, there can be no doubt that low-grade fuels should, so far as may be practicable, be utilised at or adjacent to the point of production. Providing that an assured supply of low-grade coal is available at an attractive price, the question arises as to the conditions which should obtain in order to ensure that the utilisation of such fuel is advantageous to the user. This question involves various considerations, but the main problem presented is essentially one of providing suitable steam generating plant and the correct firing equipment. It has been constantly asserted that while the utilisation of these fuels in the future is of national importance, the only satisfactory method of their utilisation is in pulverised form. The author dissents entirely from this view. Low-grade fuels have been burned in this country, as also in other European countries, in the raw condition on grates, both hand and machine fired, in increasing quantities for from thirty to forty years past.

If efficient use is to be made of those fuels which have a commercial value, instead of accumulating millions of tons as hitherto, this will only be accomplished by providing steam boilers of suitable design, with firing equipment of such a type as will ensure the most efficient use of the available fuel, at the lowest capital cost, consistent with low labour, operating and maintenance costs and reliability in service.

If these desiderata be conceded as essential, then it is submitted that to a very large extent internally-fired boilers such as those of the Lancashire type can no longer be used. Only in certain cases where the fuel has a low volatile content, and when the evaporative output demanded is very moderate, can the use of such boilers be justified. It is submitted that a water-tube boiler suitably designed, arranged, and equipped for burning fuel having a high ash content, will efficiently deal with low-grade fuels in such a manner as is clearly impossible with a boiler of any other type.

While comparatively little attention has been given to the fusion temperature of ash, in the burning of low-grade fuels this often presents a very serious difficulty. If ash in forming is subjected to a temperature in excess of its fusion temperature the formation of clinker is inevitable. The nature and condition of the clinker will depend upon the composition of the ash and the excess heat to which it may be subjected. In the case of many low-grade fuels the fusion temperature of the ash is relatively low, and when cold air is used for combustion, as the ash percentage increases so the furnace temperature is appreciably reduced. If, on the contrary, preheated air is used, while it is undoubtedly advantageous in improving the combustion conditions, increasing the rate of combustion, reducing the excess air used, and decreasing the percentage of combustible in the ash, it is frequently the cause of very serious trouble in the rapid formation of very difficult clinker and impossible operating conditions.

The alternative method of utilising certain low-grade fuels is that of pulverisation. Up to the present time there has been no opportunity of definitely determining the relative advantages of this and other systems. The author is aware that low-grade fuels have been used in pulverised form in some few installations during the past few months, under the stress of the conditions which have obtained, but whether it is more efficient and economical to burn certain low-grade fuels with high ash and moisture contents on grates or in suspension will not be settled until such time as comparative and conclusive trials are made over an extended period, with precisely similar fuels, and under normal operating conditions. Any system of utilisation which involves intermediate or preparatory treatment of fuel before its energy can be converted into useful work is clearly at a disadvantage, and all costs involved up to the time the fuel is actually fired must be taken into consideration in comparison with the use of raw coal, having in mind that there is no practical difficulty in burning raw coal as delivered despite its condition.

In considering the relative advantages of the two systems of firing, the question of ash demands attention. The problems presented in dealing with ash differ widely. When the ash is formed on a grate, one knows where it is, and it is to a large extent automatically removed. On the contrary, when the ash is all in suspension not only are the heating surfaces much more readily coated, but fusion and slagging much more easily occur. What becomes of the ash which escapes into the atmosphere in considerable quantities? The discharge of large amounts of finely subdivided material, even if it is invisible, very closely approximates to atmospheric pollution.

With very few exceptions, all fuels which may be efficiently utilised in pulverised form may also be efficiently utilised with suitable mechanical stokers.

Those fuels which are admittedly specially suitable for use in pulverised form, and which in their dry and graded condition alone are not suitable for stoker firing, are certain dry fuels finely subdivided, which, by reason of their size and physical condition, require but the minimum of drying and pulverisation.

It is imperative that such fuel should be utilised where it is produced; it would, however, be a mistake to suppose that it could not be utilised with mechanical stokers, either mixed with fine slack or in a moist condition. It is claimed that in the choice of fuels which may be efficiently burned for steam generation, there is beyond question no overwhelming advantage in favour of pulverisation. Among the most recent information available concerning the use of low-grade fuels for steam generation are details of boiler tests lately carried out at the Kashira power station, Russia, with both unscreened and screened, low-grade non-choking coal from the Moscow basin, containing a considerable proportion of fines. The approximate analysis of the unscreened coal was: Moisture, 33.1 per cent.; ash, 20.9; sulphur (volatile), 3.1; volatile matter, 21.0; and fixed carbon, 21.9. The net calorific value of the fuel equalled 4,800 B.th.u's. per lb.

The tests were carried out with a Babcock & Wilcox boiler having 3,250 sq. ft. of heating surface, a superheater, but without an economiser. The firing equipment comprised a

chain grate mechanical stoker having a grate area of 74 sq. ft. Air was supplied to the grate under pressure by means of a Schiele fan, being preheated by means of a mixture of a certain volume of the hot gases. The range of the preheated air temperature was from 265 to 390 deg. F., while a thermal efficiency of 70 per cent. was obtained, this being largely due to the use of preheated air. In a second series of tests with screened coal, the thermal efficiency was increased to the extent of 2.7 per cent.

The screened coal used had the following proximate analysis: Moisture, 30.03 per cent.; ash, 18.20; sulphur (volatile), 2.24; volatile matter, 23.97; and fixed carbon, 25.56. The net calorific value in this case was 4,418 B.th.u. per lb.

Towns' refuse has been aptly termed the lowest of all low-grade fuels. Ever varying in its composition, usually having both a high moisture and incombustible content, it is anything but homogeneous in character. Nevertheless, it possesses an unquestionable fuel value, and assuming that disposal by fire be decided upon, the available heat should be fully utilised, not only with a view to reducing the cost of disposal, but also in the interests of coal conservation. Regarded solely from the point of view of its fuel value, the utilisation of refuse for steam generation merits much more serious consideration than it has hitherto received. In a report to the Electricity Committee of the Metropolitan Borough of Shoreditch on the disposal of London refuse rather more than a year ago, Mr. C. Newton Russell, A.M.I.C.E., M.I.E.E., the then borough electrical engineer, estimated that if the whole of the refuse collected in the Administrative County of London were burned in large, modern, and conveniently located destructors, designed for steam generation, the steam being fully utilised, there would be a saving of upwards of 128,000 tons of coal per annum, and 30 million kWh could be generated yearly and sold at 0.4d. per kWh, equivalent to a revenue of £50,000. Taking into account all the charges, the estimated net cost of disposal would be 4s. 11d. per ton, as compared with the present cost in London for burning of about 9s. per ton.

Waste heat as low-grade fuel may be said to include blast furnace gas, waste gases from various types of metallurgical furnaces, gas retorts, water gas plant, and producer gas.

In a report of the Electricity Commissioners, coke oven gas is included as waste heat, while the reports for the three years ending March 31st, 1925, show that the respective annual percentages of the total units generated for the three years in question from waste heat were 3.21 per cent., 3.26 per cent., and 2.51 per cent.

Whether it is desirable to utilise such a fuel as coke oven gas for the firing of steam boilers is a debatable question, having in mind the very moderate thermal efficiency which is too often obtained. The use of blast furnace gas has not been developed in this country to anything like the extent which it should be. As ordinarily available, heavily charged with dust, the pressure varies considerably, thus introducing difficulties in adjusting the correct mixture of the air supply for combustion with burners of the aspirating type.

In the more recent practice the gas and air are conveyed to the burners under pressure, the supply being maintained at a minimum regardless of the gas pressure in the main. In the burner the gas is broken up into thin streams, the air being so introduced as to ensure complete diffusion before ignition. Large furnace volume is essential, also great length of gas travel. Compared with the early installations with water-tube boilers, furnace volumes have increased in the ratio of from 4 to 6, to 1. It is essential that the furnace brickwork be so designed as to maintain the highest possible furnace temperature.

With a draught at the outlet damper of 2.2 in. W.G., 2.9 in. pressure at the gas burners, and 1.7 in. air pressure at the burners, an average evaporation of 5.27 lb. of water per square foot of heating surface has been obtained over a continuous run of 168 hours.

Discussion.

Mr. W. D. WYLDE, in a written communication, said that the expenditure in terms of potential heat units involved in the pre-treatment of coal was not usually included in the comparative test results. With low-grade coal at 15s. per ton delivered, the heat value referred to gave mechanical stokers a 5 per cent. start in the race for maximum steam-production efficiency. He had in mind numerous instances where a 50 per cent. increase in the steam demand was comfortably met by boiler plant equipped with modern chain-grate stokers. There were the banking losses debited to the firing of solid fuel, but there could not be such a wide disparity in the losses of the two methods of boiler firing as was generally supposed.

Mr. C. NEWTON RUSSELL agreed that the pulverised fuel advocates had not yet proved their case. Recently he had had to consider whether he should go in for pulverised-fuel firing or not, and in view of the extra cost of the pulverising plant, the large staff required to look after it and the huge buildings required, together with the risk that it would not work out as expected, he had decided that the time was not yet ripe for putting down that plant. Dealing with the prevention of the emission of grit from small chimneys, he had devised a system by which the bottom of the chimney was left quite open, there being a receptacle with a volute round which the gases sped on their way to the chimney proper. It was found that 0.4 per cent. of the whole of the fuel burned was retained at the bottom of the chimney in the form of grit. He had been astonished to find that there were 4,000 B.th.u. per ton in the grit. With the pulverised-fuel firing system the grit was finer than when chain grate stokers were used, and if one were unable to catch it, it would float for miles and become a nuisance. He looked upon the coal deposits of the country as so much capital belonging to the nation in the bank; we were living on our capital, and the present wasteful methods amounted to practically a crime in some cases.

Mr. P. C. POPE agreed as to the necessity for making use of low-grade fuels when those low-grade fuels were other than coal, but did not agree that there was any necessity to make use of coal in the form of a low-grade fuel. It was very much more economical to treat the coal at the collieries and eliminate a very large proportion of the ash before it was sent to the boiler plant, and it was not a paying proposition to cart a lot of dirt to the boiler plant, heat it up, make clinker of it, handle it, and then get rid of it. If coal contained a large amount of inherent ash it should be crushed to ¾-in. and then washed. The overall cost of washing or dry-cleaning coal did not exceed from 2s. to 3s. per ton as a rule.

Mr. J. D. TROUP, referring to the coal treatment laboratory which had recently been opened at the Birmingham University, said that the equipment consisted almost entirely of various types of wet and dry plant for the screening and cleaning of coal. There seemed to be no practical reason why the gas producer should not be combined with a water tube boiler.

Mr. P. W. GRIFFIN said that the collieries should utilise the low-grade coals, but the trouble was that most of the collieries in this country used Lancashire boilers. With regard to the burning of low-grade fuels when mechanical stokers were used, he said that one necessarily had to use a high draught in order to burn the fuels, and he would like information as to the cost of maintenance of the bars, because it seemed that a lot of trouble would arise from their wearing away, melting, and so on.

Mr. J. GOLDER wondered if the statement that all fuels which might be efficiently utilised in pulverised form might also be efficiently utilised with suitable mechanical stokers were true. What about the arch in a mechanical stoker? The quality of the fuel did not make much difference in the case of a pulverised-fuel fired plant, whereas in a stoker-fired furnace there was flexibility only with regard to the area of the grid, and stoker equipment designed for a particular fuel could not be made efficiently to utilise fuels of a widely varying nature. If the statements in the paper were entirely true, capital outlay alone would be the factor responsible for prolonging the days of the mechanical chain grate stoker. It was a fact that less than 5 per cent. of the coal consumed in this country annually was used for transformation into electrical energy. If all the "unsaleable" coal produced at our collieries were turned into electrical energy and distributed among the people, the present average consumption could be multiplied by five.

Mr. W. R. GRIFFITHS said he had found that as against a Lancashire boiler using double-screened nuts at a calorific value of about 13,000 B.th.u. per ton, costing 19s., he could use a water tube boiler, with chain grate stokers or pulverised fuel equipment, with fuel having a calorific value of from 9,000 to 10,000 B.th.u. per ton, costing 11s. per ton, and in consequence of the savings effected it would pay for itself in seven or eight years.

Mr. SMEATON urged that the waste material in the dumps at the pit heads should be cleaned and utilised, and that we should look at the problem from the point of view of conserving our coal resources instead of comparing the merits of two firing systems.

Mr. P. O. ROBERTS said the calorific value of the dump face was extremely small, and could not be improved sufficiently to make the washing worth while; the consumer would not pay for the cleaning.

Mr. GOODRICH, in reply, said it was generally found that with modern machine firing equipment the cost was about the same as the application of the unit system of pulverised fuel firing. The central system for one or two boilers only would be very much more expensive. With regard to the suggestion for the elimination of ash at the point of production, he pointed out that if only 5 per cent. of the incombustible were removed at the collieries, we should save the use of 425,000 ten-ton railway wagons in this country. He agreed that the gas producer could probably be applied even to the largest of water tube boilers of every type. He was surprised that rocking firebars had not been used to a greater extent in this country, because there was not the slightest doubt that a well-designed grate of that kind for hand-firing was very beneficial indeed in riddling through the air spaces a lot of the finer incombustible, thus preserving a cleaner fire and making it easier to burn a dirty fuel. With regard to the question of grate maintenance where low-grade fuels were used, with air temperatures not exceeding 250 deg. F. the grates seemed to stand up exceedingly well; he believed Mr. Newton Russell had grates in some of the refuse furnaces at Shoreditch which had been in use for nearly 30 years. He maintained that practically all fuels which could be efficiently utilised in pulverised form might also be efficiently utilised with suitable mechanical stokers, but it was very necessary to add that the question of relative efficiency had yet to be determined. If time proved that pulverised firing was better than any other system he would be the first to hold up both hands for it.

Correspondence.

The Permissible Current-Carrying Capacities of High-Pressure Cables.

In your issue of January 7th there is an article by Mr. E. Berry Nixon giving certain sets of curves. As these stand they are of no real value and, in fact, might very much mislead.

In the first place, the permissible current that any particular cable should carry depends on several factors, none of which are so much as mentioned in the article:—

(1) Depth of cable in ground.
(2) Moisture content of soil.
(3) Ground temperature.
(4) What maximum temperature rise is allowable in the particular cable.

The article does not state on what bases the curves are prepared. Under fig. 1 there are certain reduction figures given for two cables laid together, but any particular reduction figure depends on the distance apart of the cables. It would be a different figure if the cables were 4 in. apart from when they were 12 in. apart, and the author does not say what distance apart his reduction figures are supposed to be based upon.

With regard to the curves in fig. 2, why does the author provide for three armoured cables for voltages up to 11,000 volts and for unarmoured cables at higher voltages? What has the voltage got to do with the question whether a cable will be armoured or unarmoured? One would have thought that the lower-voltage cables had better be unarmoured, seeing that they are likely to carry the heavier currents and that the sheath losses depend largely on the currents in the conductor. The sheath losses in single-armoured cables would be very great on 3-phase a.c. circuits, and consequently the heating in the sheath would have to be taken into account in fixing the allowable current in the conductor. Are the curves in fig. 2 supposed to take this into account? The losses and consequent heating in sheaths of single-core a.c. cables depend also on whether they can be worked with open-circuited or short-circuited sheaths; see paper on "The Use of Single-core Cables for Alternating Currents" by Prof. Cramp and Miss Calderwood, *Journal* of the I.E.E., April, 1923.

Then, how near are these three single cables together, and are they in triangular formation or in horizontal formation?—because this question determines, to some extent, the sheath losses and heating.

In the case of the high-voltage single-core cables the permissible current will also depend on the design of the cable, *i.e.*, the diameter of the conductor and the thickness of the insulation.

Instead of using the curves in this article, I should strongly recommend your readers to go to the proper place, *i.e.*, the "Technical Report" referred to by Mr. Nixon in the footnote on page 6. This "Technical Report" gives the loadings for various standard cables, and also states very clearly and definitely on what bases the different loadings are fixed.

For single-core cables working on a.c. circuits the maker's recommendations should be obtained.

J. A. Morton.

Prescot, *January 11th*, 1927.

Power Supply for Wireless Sets.

Having to do with a great number of wireless sets, most of them 2-valve and some 3-valve, all of the loud-speaker type, I long ago came to the conclusion that even on the 2-valve type, dry batteries are a "wash-out" for h.p. My customers were strongly urged to go over to accumulators, and none of them have regretted it.

But it has become very plain that regular touch with users is highly desirable. What happens is that, so long as the loud speaker works, the battery is allowed to drop far below two volts per cell, a 100-volt battery often going down to 70 or so without the user troubling himself.

There are two palliatives: the seller must give each customer a call every two months or so, carrying a high-pressure voltmeter; or, still better, he must try to sell to each user a small h.p. voltmeter. Moving-coil types, or those of extremely high resistance, are not required for this simple service, and there are plenty at a few shillings each which will not damage the battery in the time required to take a reading.

As to the high-pressure wattage required for good loud-speaking, remembering Mr. P. K. Turner's term as editor of *Experimental Wireless*, there is no one I would sooner listen to than to him, and, if it can be mentioned here, I have a grateful recollection of a prompt and personal reply by post on a point not very clear to me, in an issue of that journal.

A. O. Griffiths.

Caergwrle, *January 15th*, 1927.

The "H"-type of Cable.

As the question of the "pros" and "cons" of "H" cables is very much to the fore just now, it may perhaps be of help to that large class of mains engineers and consulting engineers who have not yet thought it necessary to make themselves fully familiar with the questions of potential gradient, thermal resistance, capacitance, &c., if I suggest that in the paper which I read before the Junior Institution of Engineers in January, 1925, they will find (in the Appendix) an analysis of the thermal and electrical characteristics of a 66,000-volt, three-core cable manufactured in England, and another 66,00-volt, three-core cable manufactured in France (the latter I have since gathered to have been constructed under the Hochstadter patents, but of this I was not aware at the time of making my calculations), and also of a single-core cable.

Assuming that my figures are substantially correct, then, for any who wish to compare on theoretical grounds the performance of the "H" cable (both for heating and potential gradient) with that of an ordinary three-core cable, a first approximation can be obtained by considering—and this, of course, is favourable to the "H" cable—that the "H" cable merely consists of three single-core lead-sheathed cables; and taking the calculations given in my paper referred to as a guide, an approximate idea of the relative performance of the "H" cable can be arrived at.

For those who wish to investigate the matter further, I would add that in the *Electric Journal* (U.S.A.) for February, 1926, pages 60 to 63, there is given a rather careful analysis by D. M. Simons, of the Standard Underground Cable Co. of America, of the thermal resistivity, &c., losses occurring in the metallised paper coverings, which will enable those who are so inclined to get an idea of the deficiency in thermal conductivity, as compared with that of a cable, for example, of the Henley three-core type.

Of course it must be remembered that Mr. D. M. Simons represents a company which takes a commercial interest in "H" cables, but, on the other hand, his reputation as a scientific investigator is pretty high.

I may add that, in my paper referred to, calculations for capacitance currents are also given.

A. M. Taylor,
MAJOR, S.O.2.

Birmingham, *January 10th*, 1927.

As Mr. G. H. Nash is away on the Continent, may I be allowed to clear up on his behalf a point which Mr. Nisbett has apparently misunderstood. In dealing with the point that the ability to withstand tangential stresses is considerably weakened by service conditions, he suggests that the only source of deterioration is due to mechanical causes. That cable can be seriously damaged by bad handling no one will dispute, but there is, in addition, a structural change due entirely to expansion and contraction of compound under service conditions which cannot be avoided. This expansion of the compound on heating permanently stretches the lead in spite of any reinforcement, with the result that minute voids are produced on cooling. These are most likely to be of appreciable dimensions in the filling, which is screened in the "H"-type; and are least dangerous when the stress is across their smallest dimensions, as it will be in the core insulation when the stress is always radial.

That this change occurs is shown by the power factor-voltage characteristic. Can Mr. Nisbett obtain on a belted type cable a power factor-voltage characteristic which is initially flat and is unchanged on cooling after a heat run to, say, 50 deg. C.?

T. N. Riley,
Cable Engineer,
STANDARD TELEPHONES & CABLES, LTD.

London, *January 15th*, 1927.

As all that I could usefully say in answer to Mr. Nisbett's reply to my previous letter on this subject is contained in one or other of your correspondents' remarks, I write this solely to correct a slight misprint: I am not C.E., but

C. G. Watson.

Alston, *January 15th*, 1927.

Regarding the very interesting letters that have been lately published in your journal on "H"- and "belted"-type cables, I am loth to let the subject pass without making some comment.

The mileage of "H"-type cable operating at different voltages is easily obtained, and has already been published in different pamphlets.

I notice Mr. G. H. Nisbett mentions in his last letter in your current issue the fact that there are many miles of the "belted"-type that have been working successfully for years, both at home and abroad, at 33,000 volts. I suggest it would be most interesting to all engineers if particulars of and places where these cables are installed could be published. Mr. Nisbett further points out that there are cables made by his firm installed in this country that have been alive for five years, presumably at 33,000 volts—I say presumably because one hears of other cables which have been designed for 33,000 volts, but, after being installed, have been operated at about half, or even less than half, the working pressure. Regarding the comparison of thickness of insulation, Mr. Nisbett says both types of cable need the same thickness to earth. As others have already pointed out, this is not so. Owing to the perfect distribution of the electrostatic field, the "H"-type cable can be designed to work with perfect safety with much

less insulation to earth than is necessary in the "belted"-type. It follows, therefore, that for a given size of conductor, "H"-type cables are smaller, and consequently cheaper, than the "belted"-type.

I think we must face the facts that, electrically, the "H"-type cable is a distinct advance on the "belted"-type, and, if made properly, is at least mechanically equal; whilst not wishing to be too optimistic, I think the "H"-type cable for super voltages has come to stay. Whether this be so, time will tell.

D. D. Watson.

Liverpool, *January 14th*, 1927.

Wattmeter Calculations.

Contrary to the conclusions come to in Mr. M. G. Scroggie's article in your issue of December 31st, I suggest that the volt-coil of a wattmeter should *always* be connected on the load side of the current-coil for the following reasons:—

(1) The power consumed by the volt-coil circuit can, if necessary, be quite easily and accurately allowed for when the resistance of this coil is known by simple subtraction, and the allowance is not vitiated by changes of resistance as the coil warms up.
(2) When it is required to deduce the current in the load, the volt-coil current is easily allowed for because it is in phase with the load voltage.
(3) The loss in the current-coil with any given current is uncertain to perhaps 20 per cent., or more, owing to the change of its resistance as it heats up.
(4) It is very troublesome, even when possible, to deduce the load voltage from the total because the p.d. across the current-coil is not in phase with the current in it, and the phase difference is seldom known.
(5) The volt-circuit should be joined to the terminal of the load itself, and not to that of the current-coil as shown on his fig. 1, in order to eliminate unknown losses due to the resistance of the connecting main and contacts; this is especially important where the load current is large.

Incidentally, your contributor goes a long way round in order to obtain an incorrect result. The error is the ratio of the power used in the volt-circuit, or current-coil, as the case may be, to the load power, which is the same thing as the ratio of the active currents in the one case, or of the in-phase components of the voltage in the other. The last line but one in his expressions for E is simply this same statement put down in symbols, and might far better have been written down without any mathematical gymnastics; but it is only in the second case that this ratio works out to the simple form given. In the first, it reduces to $(R_v/Z_v^2) \div (R_L/Z_L^2)$, where the Z's are the impedances of the two circuits. This gives R_L/R_v only in the particular case of unity power-factor for both circuits. Consequently, figs. 5 and 6, together with the deductions therefrom, are based on error.

David Robertson.

Bristol, *January 14th*, 1927.

Electrical Refrigeration.

Your leader in No. 2561, December 24th, is interesting, but where are the *British made* refrigerators, cooling cabinets, and home ice-making plant? The American companies which sell through English agents try, in every instance, *to sell direct to the user*; there is no percentage usually reserved to the factor, and precious little to the electrical contractor. With clients who settle quarterly, half-yearly, and annually it is not worth while to the contractor under at least 15 per cent., and the factor who takes financial risks, as well as the charges for boosting, advertising, and tendering, must have at least 10 per cent. to exist.

The American companies usually allow 5 per cent. to the contractor, *if he introduces the business*, and there is nothing further for *anyone* else, though the prices for the equipment are HIGH. There is a *great* chance for British firms, at *good* prices, even if they allow factors and the trade reasonable terms, to make and sell suitable equipment. Will any British firm rise to this and design equipment on British lines, to compete easily with transatlantic stuff, whilst giving all interests a chance to live?

Refrigerator.

January 3rd, 1927.

Great Britain's Power Resources in Truer Perspective.

Hoping all have length and breadth of vision sufficient for good perspective, may I recall attention to the position of Great Britain in relation to its consumption of electricity, while agreeing that it is justly placed by two writers in the *Journal* of I.E.E. below 14 other countries in potential water power resources? The other countries envy our abundant, cheap coal as some here seem to envy their water power.

On page 4, current Volume 65, *Journal* I.E.E., Great Britain is credited with 350,000 potential water horse-power, and on page 129 with 1,070,000. In each case the developed water horse-power is given as 280,000, which figure, I believe, is very considerably above the truth; you published my request three weeks ago for the location of the sites of those 280,000 water horse-power in Great Britain, without drawing a reply.

I should prefer to collect up-to-date figures, but time is not available. I therefore quote those dated February 3rd, 1925, as follows:—

Table I.—Kelvins Output in a Year.

1.	U.S.A.	49,802,000,000
2.	British Isles	6,400,000,000
3.	Canada	5,125,000,000
4.	Switzerland	2,700,000,000
5.	Italy	2,400,000,000
6.	Sweden	2,144,000,000
7.	Norway	1,331,000,000
8.	Netherlands	343,000,000
9.	Denmark	190,000,000
10.	New Zealand	136,000,000

It appears practical to also look at the horse-powers in relation to the areas and populations of the countries, because this places Great Britain, with her relatively small water-power resources, in a very different position in the list.

Making use of the horse-powers shown on page 129, *Journal* I.E.E., and the areas and populations in *Whitaker's Almanac*, the countries rank as follows:—

Table II.—Developed Horse-power (Water).

		Per square mile.	Per 1,000 population.
1.	Switzerland	102	410
2.	Norway	17	830
3.	Italy	14	47
4.	France	10	54
5.	Sweden (g)	8	225
6.	Japan	7	21
7.	Spain	6	51
8.	Germany	5	16
9.	U.S.A.	3	104
10.	Great Britain	2	6
11.	Canada	0.7	370
12.	Mexico (f)	0.4	20
13.	Brazil	0.2	33
14.	India	0.2	1
15.	Russia (f)	0.03	1

(f) From *Journal* I.E.E., Vol. 65, p. 4.
(g) Sweden is placed above France below.

Incidentally, on page 129 J.A.I.E.E., January, 1927, Sweden is credited with 34 per cent. more potential water power than on page 4 of the same journal December, 1926, and it credits Sweden with 1,350,000 water h.p. developed, while my reference, February 3rd, 1925, gave it as 1,950,000. Using the latter figure, Sweden has 11 water horse-power per square mile average, which places Sweden fourth in Table II above, and with 325 w.h.p. per 1,000 inhabitants.

Theodore Stevens.

London, *January 15th*, 1927.

A Motor-generator Snag.

Mr. Theodore Stevens asks for the seat of the pain in my complaint respecting difficulty with a motor-generator whose field coil burnt out when run at no load. Mr. Stevens may have no objection to field coils burning out in these circumstances, but in this respect he is exceptional. Most people prefer a generator to run without trouble.

All that is necessary is that the field coil should be made of such proportions that the field coils will not become unduly hot when the generator is run for long periods at no load.

"Rheostat" suggests a variable resistance, but one cannot rely on this in an ordinary charging station. The machines are usually run by unskilled people who regulate the current by putting lamps in series with the batteries that are being charged, or by any other method that may be handy.

One might have expected that makers would have themselves applied field coils which would stand up to all conditions of running, but my experience is that one must specify this to ensure that there will be no trouble.

Motor Generator.

January 13th, 1927.

Electric Ovens.

Is your correspondent trying an experiment in leg-pulling, or starting a "spoof" correspondence? None of the conditions which are present in an electric oven, when it is in use, fulfil the conditions necessary for the production of ozone by electrical means, and one condition which is present is sufficient to render any attempt at ozone production futile. I refer, of course, to temperature.

I have not yet heard that ozone in any concentration but the highest is damaging to bread or pastry. As a matter of fact the presence of ozone in such quantity as might be produced, even if the conditions were favourable, would be certain to improve the quality of the food, whilst being cooked in an electric oven, rather than otherwise.

Edward L. Joseph,
Managing Director, OZONAIR, LTD.

London, *January 15th*, 1927.

New Work for Contractors.

Particulars of new works and building schemes for the use of electrical installation contractors in search of work and all interested in the sale of electrical and allied plant and other products.

AMPTHILL.—Electrical installation at Scones & McMalin; U.D.C. surveyor.

ASHFORD (KENT).—Housing scheme (65), Beaver, for the U.D.C.; surveyor.

AUSTRALIA (HOBART, TASMANIA).—Factory, Sackville Street; Fur Traders, Ltd.

BARNSLEY.—Central 'bus station; borough engineer.

BEBINGTON.—Schools (£92,350), for Cheshire E.C.; F. A. Brown, county architect, Newgate Street, Chester.

BIRKENHEAD.—Additional 553 houses, Bidston, for the T.C.; C. Brownridge, borough engineer.

BLACKPOOL.—Kinema, Whitegate Drive; W. Halstead Best, architect.

BRADFORD.—880 houses, Eccleston estate; city architect.

BRIDGWATER (SOMERSET).—Housing scheme (50), for the R.D.C.; surveyor.

BURTON-ON-TRENT.—Brewery extensions, with electric lift, for James Eadie, Ltd.; T. Lowe & Sons, contractors, Curzon Street. Electricity supply, Mount Pleasant Works, Woodville; John Knowles & Co.

BURY (LANCS.).—Power and lighting installation, dairy, for the Co-operative Society; C. R. Cooper, architect, 20, Market Street.

CAERNARVON.—Town hall, Special Committee.

CAMBRIDGE.—Art school extensions (£11,830), for Cambs. E.C.; C. Kerridge, builder.

CARDIFF.—Additions to the National Museum of Wales, Cathays Park; Museum authorities.

CHELTENHAM.—Hospital extension; governors.

COLYTON.—Town hall; J. Archibald Lucas, architect, Exeter.

CORK.—Wharf and stores (£8,220); city engineer.

DAGENHAM (ESSEX).—Housing scheme (75), for the U.D.C.; surveyor.

DARWEN.—35 houses; borough engineer.

DUNDEE.—Proposed extensions at Baldovan Institute for Children (£40,000); Mr. R. Freer Myles, clerk to Forfar District Board of Control, Forfar. Proposed 500 additional houses for Corporation; city architect.

EASTCOTE (MIDDLESEX).—Kinema, Field End Road; Telling Bros., Ltd.

EDINBURGH. — Gynecological and maternity hospital; Medical superintendent, Royal Infirmary.

EGHAM (SURREY).—Housing scheme (100), for the U.D.C.; surveyor.

ELLESMERE PORT (CHESHIRE).—Additional 80 houses, for the U.D.C.; surveyor.

FENTON (STAFFS.).—Erection, Camacs Potteries; Baker and Co., Ltd.

FERRYHILL (Co. DURHAM). — Kinema, Main Street; W. J. R. Wallace, architect, North Shields.

FLEETWOOD.—Extension of Fleetwood Hospital; hon. sec.

GLASGOW.—Premises for Boots, Argyle Street and Union Street (£50,000); Campbell & Harley, 18, Duke Street, Edinburgh. 156 houses in Govan (£61,327); Messrs. Robert Anderson & Co., builders.

GOLDENHILL.—40 houses, Collinson Square; Stoke City engineer

HAYES.—100 houses; U.D.C. surveyor. 50 houses; Great Western Garden Village Society.

HESTON.—48 houses, Bulstrode Avenue; W. H. Allen.

HORSFORTH (LEEDS).—54 houses, Cragg Hill; J. Davidson, clerk to Council.

ISLEWORTH.—80 houses, Victoria Gardens, &c.; W. W. Harbrow.

KETTERING.—Hospital extension; Joint Hospital Board.

KIDDERMINSTER.—Dance hall, Vicar Street, for the Midland Counties Circuit, Ltd. Carpet weaving shed, Green Street, for T. & A. Naylor. Municipal offices, Mill Street, for the T.C.; borough surveyor.

LEISTON (SUFFOLK).—Re-erection of Leiston Hall, residence of A. J. Wearey.

LINCOLN.—Central 'bus garage and workshops, and additional 20 houses, for the T.C.; city engineer.

LITTLE HULTON (NEAR BOLTON).—Housing scheme (46), Worsley Road; surveyor to U.D.C., Council Offices.

LONDON (EAST HAM, E.).—38 tenements, Central housing estate; Johns Bros.

(ILFORD, E.).—Schools, Valentines, for the borough E.C.; Adam Partington, clerk.

(MUSWELL HILL, N.).—Congregational Sunday school (£10,000); trustees.

(GREENWICH, S.E.).—Dismantling and removal of six water-tube boilers, with economisers, at Greenwich power station; general manager of tramways.

LONDON—*continued.*

(CAMBERWELL, S.E.).—Isolation accommodation, Grove Hospital; J. Crewsdon, of Horley.

(PECKHAM, S.E.).—Rebuilding 138, 140, 142, and 144, High Street; Selfridge & Co., Ltd.

(TOOTING, S.W.).—Sisters' Home at South-Western Hospital; W. S. Sharpin, Bow.

LUTON (BEDS.).—Factory extensions, Collingdon Street, for Lincoln, Bennett & Co. Shops, Ridgway Road, for the Industrial Co-operative Society. Block of shops, George Street, for Edgson & Wilsdon.

LYTHAM ST. ANNES.—Sewage disposal works (with pumping machinery); G. W. Lawson, borough engineer.

MACCLESFIELD.—Housing scheme (48), for the T.C.; borough surveyor.

MAIDENHEAD.—Additional 60 houses, for the T.C.; borough surveyor.

MAIDSTONE.—Re-erection of the Len Cabinet works, Water Lane (£10,000); the proprietors.

NESTON AND PARKGATE.—Waterworks pumping station, for the U.D.C.; H. B. Ward, engineer, Commerce Chambers, 15, Lord Street, Liverpool.

NEWBURY (BERKS.).—Housing scheme (80), for the T.C.; borough surveyor.

NORTHALLERTON.—Registry of Deeds building (£10,584), for North Riding C.C.; D. Oakley, builder.

OLDBURY.—Re-erection of kinema, Freeth Street, for C. Dent.

OLDHAM.—Maternity home (£9,000); borough engineer.

PLYMOUTH.—96 flats, Mount Stone, Stonehouse; borough surveyor.

PORTSMOUTH.—56 houses, Merthyr Road, Cosham; Gammons & Coffin. Block for 62 patients, Milton mental hospital; E. H. Harvey, architect, The Square.

REIGATE.—Housing scheme (40), for the R.D.C.; W. J. Hatton, surveyor, 48, High Street.

ROMFORD.—Houses (64), for Harber & Cox.

RUGBY.—Extensions, Hospital of St. Cross (out-patients' and administrative block); Young & Hall, architects, Southampton Street, London, W.C.

SALE.—Secondary schools, for Cheshire E.C.; F. A. Brown, county architect, Newgate Street, Chester.

SALFORD.—Trades Exhibition Hall, &c., on Cattle Market site; chairman, Exhibition Hall Committee.

SCUNTHORPE.—Housing scheme (38); W. Farrar, engineer and surveyor, Council Offices.

SHEFFIELD.—New kinema, Barkers Pool; Provincial Cinematograph Theatres, Ltd., Regent Street, W.

SOUTHPORT.—Kinema, Liverpool Road, Ainsdale; Southport Coliseum Co., Ltd.

SOWERBY (YORKS.).—Housing scheme (77), for the U.D.C.; surveyor.

STARCROSS.—Extensions, mental hospital; Devon C.C.

STOKE-ON-TRENT.—Wholesale market; city engineer.

TORQUAY.—Houses (52) and seven shops, Barton Nursery estate, for A. Nettleton. Houses (62), Barton Road, for G. E. Tozer. Additional 36 houses, for the T.C.; borough surveyor. 100 houses; borough engineer. Central depôt (£3,500), for the T.C.; borough surveyor.

TWICKENHAM.—Development of the Carpenters' Company estate for 300 houses; Sir B. Fletcher, F.R.I.B.A.

WAKEFIELD.—Electric lighting, Alverthorpe School; education director. Electricity supply, Silcoates School; managers.

WARRINGTON.—Housing scheme (258), for the T.C.; A. M. Ker, borough surveyor. 60 houses, Bewsey estate; borough engineer.

WATFORD.—Housing scheme (124), for the T.C.; W. W. Newman, borough engineer. Extension and improvements, Leonesden Asylum (£107,000); Metropolitan Asylums Board.

WEMBLEY.—Hospital; H. Kenchington.

WHETSTONE (HERTS.).—70 houses, Totteridge Lane; R. F. Peachey & Sons.

WOLVERHAMPTON.—Extension of Wolverhampton and Staffs. Hospital (£45,000); W. Sharratt, Ltd., builders, Wolverhampton. Schools, Low Hill (£16,500), for the borough E.C.; Mr. Warren, director of education. Extensions, Staffs. Hospital (£45,826), for the Board of Management; Elcock & Sutcliffe, architects, Northumberland Avenue, London. W. Sharratt, Ltd., builders.